PUBLICATION OFFICES

168-177 POTTER BUILDING, NEW YORK.

Telephone Call: Murray 586. Cable Address: "Electrical," New York.

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VOL. XI. NEW YORK, FEB. 4, 1888. No. 5.

CONTENTS.

ILLUSTRATED ARTICLES: PAGE.

Efficiency Tests of Electric Motors for Amateurs 50
The Fisher Electric Railway at Detroit 51
A New Thermostat 52
A Portable Electric Light Plant 53
Experiments on the Possible Electrolytic Decomposition of Certain Alloys 53
Kennedy's Compound Wound Dynamo 54
The Incandescent Light "Freak" 54
The Menges Thermo-Magnetic Generator and Motor 55
Portable Voltmeters for Measuring Alternating Potential Differences (Continued) 56
The Induction Top 56

NEW BOOKS:

"Management of Accumulators and Private Electric Light Installations" 50

CORRESPONDENCE:

A Useful Electrical Society .. 50

EDITORIAL PARAGRAPHS 49

MISCELLANEOUS: PAGE.

Windmills for Generating Electricity 51
Electric Osmose and Electro-Capillary Action 51
The Patent Reform Question Once More 52
The Agitation for Government Telegraphs 52
Converting a Holtz Machine Into a Motor 55
An Important Decision as to Telephone Rates at Rochester, N. Y 55

SPECIAL CORRESPONDENCE:

New York Notes 57
New England Notes 57
Philadelphia Notes 58
Western Notes 58
English Notes 59

DEPARTMENTS:

The Telegraph 59
The Telephone 59
The Electric Light 60
Applications of Power 60
Personals 60
Miscellaneous Notes 60
Business Notices 60
Our Illustrated Record of Electrical Patents 60

New Advertisements.

In the growth of THE ELECTRICAL WORLD in circulation, size and general improvement, the value of its columns for reaching those engaged in electrical pursuits or interested in electrical matters has not failed to be appreciated by advertisers. Readers will find it to their advantage to keep their eyes on the advertising as well as the reading columns. The following are the new advertisements in this issue:

PAGE.

Otis Bros. & Co.—The Baldwin Gas Engine i
The Armington & Sims Engine Co.—High-speed Engines for all Systems of Electric Lighting iii
The Ansonia Brass and Copper Co.—A. A. Cowles' Patented Fire and Weather-Proof Wire iv
Edison Electric Light Co.—The Edison Direct System of Central Station Electrical Distribution v
Viaduct Manufacturing Co.—District Telegraph Call Boxes vi
Sawyer-Man Electric Co.—Automatic System of Incandescent Lighting vii
Phœnix Glass Co.—Arc and Incandescent Electric Light Globes .. viii
Shultz Belting Co.—Belts for Dynamo Use viii
Hartford Steam Boiler Inspection and Insurance Co x
Automatic Electric Service Co.—A New Departure xi
W. L. Libbey & Son.—Electric Light Globes xi
Bentley-Knight Electric Railway System xiii
Electric Manufacturing Co.—Standard Electrical Test Instruments xv
Bell Telephone Co., of Missouri.—Magneto Bells for Sale xvii
Johnston's Patent Agency.—Electrical Expert Work xvii
The Ball Engine Co.—The Ball Automatic Cut-off Engines xvii
George W. Lord.—Lord's Boiler Compound xviii
The D. M. Steward Manufacturing Co.—Laya Insulators xx
W. P. Phillips.—Cylinder and Journal Lubricators xx
Taper Sleeve Pulley Works.—Friction Clutch Pulleys xx
The Westinghouse Electric Co.—The Alternating System xxi
The Electrical Accumulator Co.—Electrical Accumulators or Storage Batteries xxi
George W. Lord.—Danger from Boilers Prevented xxiii
The American Tool and Machine Co.—Belt Controllers for Dynamos, etc xxiii
American Waltham Watch Co.—Waltham Non-Magnetic Watches xxv
Callender Insulating and Waterproofing Co.—Trinidad Line Wire xxv
The Schuyler Electric Co.—The Schuyler System of Electric Lighting xxvi
Schaefer Electric Manufacturing Co.—Dynamo Machines and Incandescent Lamps xxvii
Wants, For Sale and Special Notices xv

The Static Induction Motor. IT would at first sight seem absurd to talk of a static electrical machine running as a motor, but that the usual static machine, such as the Holtz, can be converted into a motor when supplied with a continuous charge from a second machine is an established fact. As suggested in another column, it would be interesting to know what the efficiency of such an apparatus is. The experiment made at Cornell by Prof. Nichols proves once more the correlation of the natural forces, and the special flexibility of electricity for conversion into other forms of energy.

Patent Law Reform. THE diversity of opinion as to patent reform continues to display itself. Last week we had an article from Mr. E. C. Davidson against the proposed reform agitation, and this week Mr. G. H. Stockbridge presents an article on the side of Mr. Steuart. Another noteworthy utterance is that of Mr. C. A. Brown before the Chicago Electric Club. Mr. Brown is so closely identified with large manufacturing and patent interests that his objections to patent reform will be sure to meet with respectful hearing. He has, moreover, considerable legal aptitude, as his paper showed, and is evidently alive to the importance of the constitutional issues involved. Mr. Brown's conclusion is that no action looking to patent "reform" should be taken without practical unanimity of the members of the body which is asked to give its authority and influence to the measure.

Impressive Executions. MR. ELBRIDGE GERRY, of the commission which reported recently in favor of electrical executions, has been interviewed as to the hanging which he witnessed last week in this city. That execution was, it so happened, a complete success, if it may be thus described, but Mr. Gerry remains entirely favorable to electricity, both as regards its certainty and its weight of awe. "There can be no doubt," he said, "that execution by electricity would be quite as impressive as that by hanging. There was nothing impressive about the execution I saw this morning." It may be that electrical executions would be as attractive as those which my Lord Tomnoddy and his tiger Tim were wont to witness, but we doubt it. Such a swift and sudden death, unaccompanied by elements of sensationalism, would probably frighten and repel the most brutally inquisitive.

The Induction Top. PHENOMENA whose action has often taken months of investigation to reduce to laws, are now demonstrated by the most simple apparatus, and this is well shown in the toy called the induction top, illustrated on another page. Its action illustrates the great laws of magnetism and magneto-electricity. It would seem that an addition to this excellent experiment might be introduced which would illustrate electrical resistance as well. Thus, by constructing tops of different metals, such as iron, copper, German silver, etc., the induced currents generated in each would be varied, generally according to the specific resistance of the metal of which it was composed; and hence the repulsive action shown by the tops constructed of different metals would be varied in a similar manner. Other similar experiments might be suggested, but we leave it to our readers to work out the idea.

The Incandescent Lamp "Freak." THE curious example of the rupture of an incandescent lamp, brought to notice by Mr. G. W. Blodgett, and illustrated by us recently, has brought out several contributors who have encountered similar "freaks" in their practice. In to-day's issue Mr. E. A. Colby describes these freaks in a thoroughly scientific manner, and bears us out in the theory which we advanced at the time as accounting for the accident, as shown. In order that our readers may be able to follow Mr. Colby's able and neat analysis more conveniently, we have reproduced the engraving of the lamp on another page. We believe that the points made are thoroughly well taken, and in accordance with the facts presented. Mr. Colby adverts to the fact that nothing was mentioned with regard to the disintegration of the carbon filament, but we may add that within the lamp, after its rupture, there were found at the bottom quite a number of grains of the carbon filament scattered about in a loose heap. According to Mr. Colby's argument, the rupture of the bulb followed the rupture of the carbon, and not *vice versa*, as was suggested at first.

Electric Cars in Winter. SO FAR as we can ascertain electric cars all over the country, subjected to a most severe and trying winter, are doing very well. Here and there a little trouble has been experienced, but none that could really be attributed to the cars or the electric system. In New York there has been the spectacle of the Julien storage car tackling some of Mr. Mailloux's "mountainous" grades in the vilest weather, with undeniable ease and success, and altogether the winter has done much to demonstrate the efficiency of electric systems. Of course, where a man has his tracks so flooded that he has to break through thick ice to find them, it is hardly fair to blame the electric motor. Under such circumstances it might be well to run on top of the snow and ice, and, after all, we do not see why light omnibuses or similar vehicles, equipped with electric motors, and taking current from overhead wires, but not dependent on any track, could not be run with profit. With extensible connectors, such 'busses could wander about the road at will, picking their way like a horse conveyance. It is not impossible that such lines might succeed in small places where it never would pay to lay regular tracks. We throw out the suggestion for what it is worth.

The Pyromagnetic Generator. TOWARDS the end of last year it was remarked in these columns that the present year would without doubt see a remarkable activity in the field of thermo-electricity, and, new as the year is, sufficient work in this field has already been chronicled to fully justify the prediction made at that time. Nearly every one of our issues since the beginning of the year has contained one or more original articles on this subject, and not the least interesting part of these articles lies in the fact that they represent work accomplished some time ago which lay dormant, and which is now revived by the interest shown in the subject. Our columns this week again give evidence of this fact, the apparatus described being of a most interesting character. Although it resembles that of Mr. Edison on some lines, the details differ sufficiently to give it a decided stamp of originality. Mr. Menges' apparatus works on the method of increasing and decreasing the magnetic resistance of the magnetic system by the heating of an intermediate piece inserted in that circuit. The utilization of this principle without the employment of heat, has, however, been recently employed as a means for the regulation of dynamos, and thus we are approaching nearer and nearer every day to the time when the electric circuit and the magnetic circuit will generally be treated in a like manner, and when a comprehensive theory of the relation between electricity and magnetism can be formulated.

Inter-State Telegraphy. WE publish on another page extracts from an article in this month's *Forum*, by Senator Cullom, on the subject of government telegraphy. The Senator says nothing new, but his views have interest as being representative of those entertained by a large portion of the public and as being embodied in measures now before Congress. It is to be observed that Mr. Cullom favors placing telegraphic business under an Inter-State Commission. A bill to this end was introduced in the National Senate last week by Mr. Spooner, and it appears to us more likely than any other legislative project to receive approval and attention. There are many grave and serious objections to government ownership of railroads and telegraph, as there are to like ownership of express services and steamships, and we have never flagged in our efforts to point out the difficulties and dangers. But vigilant supervision on the part of the public through its officers, is quite another matter, and Mr. Cullom would find in it adequate protection of the general community without any spoliation of private property or discouragement of individual enterprise. As to Mr. Cullom's assertion that the Western Union Company has bought up fifty competing concerns at a fraction of their cost, we must remark that that is not the customary argument. Besides, it is not the fact. The general idea is that the properties taken into the Western Union system are offset by stock in several cases many times their value —"water," in fact—and in the other cases not far from a reasonable price: Even the sale of the Baltimore & Ohio plant, which we were extremely sorry to see and believe to have been a public misfortune, was not "confiscation" in any sense of the word.

Windmills for Storage Batteries. THE availability of the windmill as a source of power for the driving of dynamos and the charging of storage batteries has been the subject of frequent discussion, and in another column Mr. Wolff touches one side of the question in a manner which deserves attention. Mr. Wolff, as a recognized authority on windmills, shows that this form of prime mover is thoroughly well developed. It is well applicable as a means of converting wind power into mechanical work, and windmills have now been brought to such a point that the irregularity of motion, which is generally considered to be one of their attributes, does not exist in effect, methods of regulation being applied to them analogous to that of the steam engine, by means of which their speed remains constant at all velocities of the wind. Mr. Wolff also adverts to the fact that the average for at least four hours out of 24 hours, of each day, the wind exceeds six miles per hour the lowest at which windmills are set to operate; and that the average velocity of wind is 16 miles per hour during 8 hours of the day. Taking this condition of the windmill as a basis, Mr. Wolff argues that the reason why the combination of windmill and storage battery plants has not yet been generally attempted is due to the fact that the accumulator does not seem to be a satisfactory and assured success. The latter assumption, however, is by no means warranted. The result of several years' operation of storage batteries shows that they are perfectly reliable when properly attended to. This being the case, therefore, and the windmill being an assured success, there ought now to be no obstacle in the way of a thorough utilization of a large force in nature, which is comparatively little employed. We know as a matter of fact that experiments in this direction have been going on for some time, and it is not hard to conceive that within a comparatively short time the storage battery, charged by a dynamo driven by windmills, will be a common sight.

NEW BOOKS.

MANAGEMENT OF ACCUMULATORS AND PRIVATE ELECTRIC LIGHT INSTALLATIONS. By Sir David Salomons, Bart. Third edition, revised and enlarged. London: Whittaker & Company. New York: D. Van Nostrand. 1888. 150 pp., 5 × 7. Price $1.50.

Sir David Salomons, from the long experience he has had in storage batteries under his personal supervision, is probably as well entitled as any one to speak upon their practical and successful management, and in the little volume before us he has given with perfect frankness the results of his experience with them. The present edition is nearly twice the size of the last, and is correspondingly enlarged in scope by the addition of matter which, while not bearing directly on storage batteries, is valuable to every owner of any kind of isolated plant. The work treats very fully of the storage battery cell, describing its construction and the method of its setting up, charging and discharging, and the causes of failure as well as their remedy; the details of which are most interesting at this time, when the storage battery is asserting itself as a factor in domestic electric lighting. The part of the work referring to installation generally contains some valuable tables showing the cost of lighting by different methods, and with different apparatus. The book is illustrated quite freely, and is made specially valuable by a very complete index. We are glad to be able to recommend such a useful and practical work, whose reappearance is so timely.

Efficiency Tests of Electric Motors for Amateurs.*

BY W. F. D. CRANE.

My purpose in presenting this paper before the association is to describe clearly and briefly, for the benefit of those who as yet have but a limited knowledge of electricity, the methods and apparatus employed in the tests for determining the efficiency of an electric motor.

As is well known, any self-exciting dynamo can be used as an electric motor by reversing its function as a generator and supplying it with electrical energy to be converted into mechanical energy. Hence it will be seen that the methods and apparatus described below are equally applicable for determining the efficiences of dynamos as well as motors, with this distinction, however, that since the efficiency of any machine is the ratio of the power put into the machine and the useful work given out, in the case of a dynamo, we have to determine the ratio of the mechanical work expended in turning the armature to the electric energy produced. In a motor we wish to find just the reverse; that is, the ratio of the electric energy contained in the current supplied to the motor to the mechanical energy given out in useful work.

The losses occurring in both machines during the conversion of electrical into mechanical energy, and *vice versa*, are identical, and may be localized as follows:

1. Friction at the bearings; air friction, due to the rapid revolution of armature; and the friction of the brushes against the commutator.

2. Energy lost in the heating of the wires in armature and field coils; voltaic leakage, or leakage between the wires, and a certain loss due to self induction.

3. Magnetic leakage into the air and loss by the production of eddy or Foucault currents in the iron parts of the motor. These eddy or Foucault currents are useless currents which are set up in the iron in armature and field magnets by the mutual inductive effects of the magnetism in armature and field magnets and of the current passing in the armature.

The energy of a current can be expressed, provided we know the number of ampères and the number of volts of potential between the two ends of that part of the circuit in which the energy to be measured is being expended. The number of ampères is measured by a suitable ampèremeter; the number of volts by a suitable voltmeter. The product of the volts into the ampères expresses the electric energy expended per second in terms of the unit of activity, denominated "watts." As one horse-power is equal to 746 watts, the number of volt-ampères (*i. e.* watts) must be divided by 746 to express the result in horse-power. But the current equals the E. M. F. divided by the resistance—Ohm's fundamental law—or, $E = CR$, and $CE = C^2R$. Hence, it will be seen that, if we can determine any two of the three quantities E, C and R, belonging to the armature, shunt or main coil circuits, we can find the electrical horse-power in that circuit.

For example, suppose we want to find the electrical horse-power consumed in the armature of a motor or dynamo. We find its resistance R, when the machine is at rest, measure the current C passing through it when the machine is in motion, and by the above formula, C^2R, readily determine the number of watts consumed therein. Dividing by 746 gives us the horse-power.

There are three efficiencies which we may test for in an electric motor, viz., the efficiency of conversion, the electrical efficiency and the commercial efficiency.

The *efficiency of conversion* is the ratio of the electrical energy supplied at the terminals to the power actually obtainable at the armature shaft; and this should never be less than 90 per cent. in medium sized and large motors. The balance, or 10 per cent., would be the percentage of energy wasted in the losses enumerated in (2) and (3), and would include the percentage of loss due to defective construction and an ill-proportioning of parts composing the motor.

Or, expressed in symbols,

$$E_c = \frac{w + f}{E\,C}; \qquad (1)$$

where w is the useful power given out, f the friction, both being expressed in watts, and $E\,C$ the electric energy supplied, as measured at the terminals.

This formula shows the capacity of the motor for utilizing the energy of the current supplied, and its determination is useful in that it shows the proportion of the electrical defects, and also requires a determination of the loss from friction which may lead to its economic reduction.

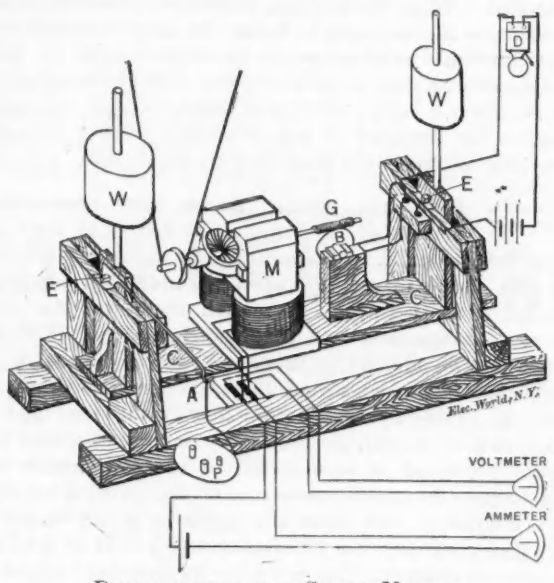
The *electrical efficiency* is the ratio of the external electrical energy to the total internal electrical energy; that is, to the total electrical energy consumed in armature, shunt or main coil circuit.

Or,
$$E_e = \frac{K}{E\,C} \qquad (2)$$

The *commercial efficiency* is the ratio of the external electrical energy applied to the useful work given off.

Or,
$$E = \frac{w}{E\,C}. \qquad (3)$$

In measuring the mechanical power given off by a motor, or consumed by a dynamo, it is now almost universal to employ the Brackett cradle. This, as shown in the accompanying diagram, consists of a firm bed and uprights, the tops of which support the cradle proper C resting on knife-edges E. The motor is accurately centred on this cradle, so that the axis of the armature passes through the points of support of the knife-edges. Counterbalancing weights W W are so placed as to balance the weight of the motor M, scale pan P and dynamometer arm A projecting horizontally from knife-edges. A friction brake or suitable apparatus, connected by belt with the motor pulley, is placed vertically above or below for the purpose of consuming the power given off by the motor for various currents and at various speeds. In lieu of a suitable brake, a dynamo may be used with adjustable lamp or resistance loads. The revolutions are counted by means of a wheel and worm G inserted at the end of the armature spindle. A platinum point at B on the side of the wheel comes in contact with a spring or mercury cup at each revolution, thereby ringing a single stroke electric bell D. All external connections in testing small motors should be made in mercury, so as not to introduce errors which would otherwise arise if wires were led directly to the motor.



DYNAMOMETER FOR SMALL MOTORS.

The figure shows a wooden cradle designed for the testing of small motors not much over ¼ h. p. This cradle is built of well seasoned ash with a base 28 inches long, is one-third as wide, and the supports are about 1 foot high. The supports are placed 19½ inches apart and carry on their tops grooved steel plates as bearing surfaces for the knife-edges. The swinging cradle has an available platform 16 inches long by 6 inches wide. The knife edges are rigidly attached to nuts threaded upon the vertical iron bars supporting the counterbalancing weights. This permits of a limited adjustment of the cradle proper vertically in either direction, which adjustment, when made, is rendered secure by a lock-nut on the top of the cradle where the rod protrudes from the wood. When testing for such small powers it is especially necessary, for the sake of accuracy, that all extraneous friction or displacements should be avoided; hence all connections are made in floating mercury, as shown. The dynamometer arm is 30 centimetres long, and a short scale (not shown) projecting from the side of the support, serves to show when the cradle has reached its position of equilibrium, or zero point. In large cradles, designed for testing machines of several horse-power, the scale pan is replaced by a weight sliding on the dynamometer arm and the speed is taken by hand with an ordinary dial speed counter.

By this cradle arrangement the motor is virtually converted into its own dynamometer. The instant that it does work there is a reaction between the armature and field magnets which causes a displacement of the cradle. By placing weights in the pan, the dynamometer arm can be restored to its position when at rest; then the couple formed by the weight in the pan and dynamometer arm serves to balance the force of the reactions. By a determination of the speed at the same time, the power given off in foot-pounds per minute is expressed by the formula $w = 2\pi Pdn$; where P is the weight in the pan in pounds; d the length of the dynamometer arm in feet, and n the number of revolutions per minute. Dividing this by 33,000 gives us the horse-power.

Or this formula, when P is given in grammes and d in centimetres, gives w in gramme-centimetres, and must be divided by 7.6×10^6 to express w in horse-power; or, to express it in watts, it must be multiplied by 981×10^7.

The current and potential measuring instruments are placed in the circuit as shown diagrammatically in the figure.

The friction may be readily determined by revolving the motor armature by another motor or suitable apparatus substituted in the place of the brake. Dynamometer readings at different speeds may then be taken, as before. The terminals must be open to avoid converting the motor by this reversion into a dynamo.

We have now all the terms necessary to find the efficiency of any electric motor. In practice, simultaneous readings are taken of the current, E. M. F., speed and dynamometer.

The following table shows the tabulated results of tests for the commercial efficiency of a small series motor, such as is used for running sewing-machines and other light machinery. The column under "Dyn." gives P in grammes:

C.	*E.*	*E. C.*	Speed.	Dyn.	*W.*	Eff.	H. P.
10	8.75	85.5	1,440	154.5	41.14	.47	.055
19.5	10.45	109.7	1,920	150.	53 25	.485	.071
10.5	12.07	126 73	2,400	140.	63.13	.49	.084
10.07	13.87	139 74	3,240	126.	75.49	.54	.09

To find the efficiency of conversion, we may take as an example the data of the first test, when the motor was running at a speed of 1,440 revolutions per minute, with a current of 10 ampères and giving an output of 41.44 watts. The friction at the same speed was 8.3 watts. Substituting in (1) we have

$$\frac{w + f}{E\,C} = \frac{41.14 + 8.3}{87.5} = 57 \text{ per cent., nearly.}$$

The resistance of the armature was .2 ohm, and of that of field .28 ohm, a total of .48 ohm. Taking the same test when the current was 10 ampères, the total internal electrical energy consumed in armature and field coils would be $C^2\,R = 10^2 \times .48 = 48$ watts. We then have for the electrical efficiency, by substituting in (2),

$$\frac{K}{E\,C} = \frac{48}{87.5} = 55 \text{ per cent., nearly.}$$

Though the cradle above described is built on a plan of lightness and of a size for the accommodation of motors of less than one-quarter horse-power, it will serve as an illustration of the cradle enlarged and constructed wholly of metal for the testing of motors of many horse-power. There are many dynamometer methods and several modifications of the Prony brake which have been used with more or less accuracy for determining the power given off by a motor; but the Brackett cradle has the great advantage of permitting of very delicate adjustment, and ease and accuracy of dynamometer readings. Its *disadvantage* consists in the time and excessive care necessary in the mounting of the motor and making of all adjustments, which make it an instrument more suitable for the laboratory than the practical requirements of the workshop.

* A paper read before the Electrical Engineering Association of Cornell University, Dec. 9, 1887.

A Useful Electrical Society.

To the Editor of The Electrical World:

SIR: I take great pleasure in announcing to you that the Philadelphia Electrical Society is now in a very flourishing condition, having a membership of 167 members in good standing. The regular business meeting of the society is held on the first Saturday night of each month. On Monday night, the 9th of January, the Electric Light Beneficial Association met in the rooms of the society, when the writer addressed them on the dangers of electric light wires. A request has been made that it be repeated at some future meeting. Wednesday night, the 18th of January, the society listened to a very able paper by Mr. H. B. Cutter on the construction and care of open circuit batteries. On Saturday night, January 21, Mr. C. M. Knapp delivered a paper on electrical measurements and the theory of the Wheatstone bridge, which was very satisfactorily exp'ained. A special committee was also appointed to invite the manufacturers of lightning arresters and wire protectors to be present at a future meeting, when practical tests will be made to determine the best one for different kinds of work. The rooms of the society are very nicely fitted up and are open for the use of members from one to twelve P. M. There has already been quite a donation of practical testing instruments as well as papers and pictures.

PHILADELPHIA, Jan. 23. M. D. LAW, President.

The Fisher Electric Railway at Detroit.

We have at various times given accounts of the Highland Park Railway, at Detroit, Mich., which has been in operation for over a year, and are now enabled to illustrate the system, which is due to the inventive genius of Mr. Frank E. Fisher. In the illustrations, for which we are indebted to the *Street Railway Journal*, Fig. 1 shows the motor complete and Fig. 2 one form of the car arrangement employed.

As will be noticed, current is supplied by a third rail supported upon insulators placed in a conduit 8 in. square.

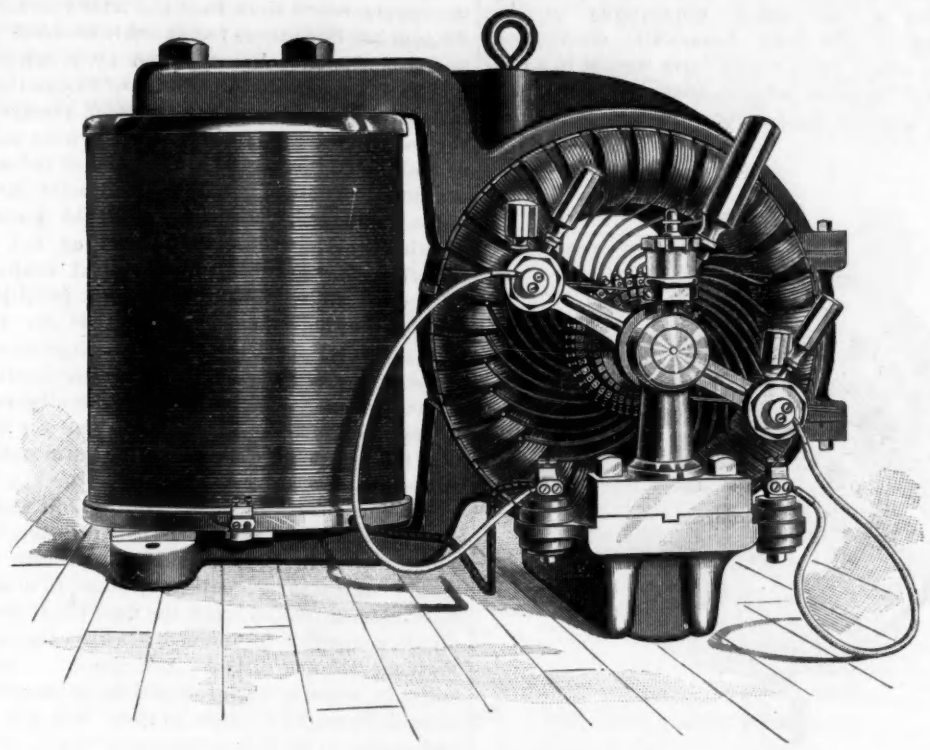


FIG. 1.—FISHER ELECTRIC MOTOR.

The conduit has a slot opening ¾ in. wide, in which the contact wheel or device travels, bearing directly upon the conductor within.

Mr. Fisher employs two methods of attaching the motor to the car. In one he suspends the motor under the car, and in the other method, which is illustrated in Fig. 2, the motor is placed on the front end of the car, which is inclosed by a cab, the motor man acting also as a conductor, having charge of the fare box.

The length of the road is 3¾ miles, and, being a suburban one, comparatively high speeds can be attained. Thus, it is said that the average speed attained is 18 miles per hour.

At present there are running on this road four cars equipped with 10-h. p. motors, giving them sufficient capacity to haul an extra car with full load. The generating dynamo is of 25,000 watts capacity, and delivers the current at a potential of 500 volts to the cars. The road has an extremely neat and compact station at the Detroit City end of the line, convenient to the railroad from which fuel supplies are obtained.

Windmills for Generating Electricity.

BY ALFRED R. WOLFF, M.E.

The credit of first suggesting the use of windmills for driving dynamo machines to charge electrical accumulators belongs to the eminent physicist and electrician, Sir William Thomson, and dates back to the year 1881, viz., to a presidential address delivered by him before Section A of the British Association for the Advancement of Science, "On the Sources of Energy in Nature Available to Man for the Production of Mechanical Effect."

It is true that in the same paper, and at the same time, Sir William threw some cold water on his own suggestion by urging as a difficulty to the adoption of the windmill in its (then) present state of development, that the first cost was too great.

In this, however, as I have pointed out in detail elsewhere [See "Note on the Economy of the Windmill," Trans. Am. Soc. of Mech. Eng'rs., Vol. III., 1882, and 'The Windmill as a Prime Mover," New York; John Wiley & Sons, 1885], he erred in overlooking the fact that interest on capital, not capital itself, is an item, and by no means the only item, of current expense by which the economy of prime movers should be judged. I then showed, and now repeat, that when the only correct basis of comparison of the economy of different prime movers is instituted, viz., the cost of obtaining the horse-power developed per unit of time, such cost consisting of the sum of interest, repairs and depreciation of plant, cost of fuel, oil and attendance, and similar items of expense entering the power account, the windmill is the most economical motor for the development of power in moderate and small quantities.

It is safe to maintain that the reason windmills have not thus far been put to practical use for the generation of electricity is not due to the first cost of the motor, nor to any lack of economy in operation.

I here wish to emphasize the fact that the non-employment of the windmill, in this connection, is also not owing to the often alleged fact that the rate of revolution of the windmill, according to varying force of wind, is too irregular to run a dynamo for the purpose of charging a storage battery, or that the wind cannot be depended on for a sufficient length of time per day.

The real facts of the case are that in the leading American windmills, as is attested by hundred thousands in daily use in pumping practice, governing appliances of various kinds, of approved design and experience, automatically so vary the extent of surface presented to the wind, that a practically uniform rate of revolution is obtained, irrespective of direction and varying velocities of wind, for all winds exceeding a velocity of six miles per hour. This latter velocity must be reached before windmills of good design, as ordinarily constructed, operate at the rate of revolution for which they are set. It has been found, by experience, that, on an average, for at least eight hours out of the twenty-four hours of each day, the wind exceeds this velocity of six miles per hour, the average velocity of wind during the eight hours of run being sixteen miles per hour. Total calms in excess of two days' duration are, practically, unknown in the United States.

The fact that the windmill is at rest, often at short intervals, aggregating not quite sixteen hours out of the twenty-four, is no objection to the use of this motor for the purposes of driving dynamo machines to charge electrical accumulators, for one of the very features and acknowledged requisites of such accumulators should be that they can be charged spasmodically at will, and at odd times.

The result of study of this question must be that the reason windmills are not used in this way is not that the windmills are not sufficiently economical or reliable, but that the electrical accumulators are not yet a satisfactory and assured success. When they are, windmills will come into extended use as prime movers for the generation of electricity, and electricians will be glad to avail themselves of the most economical motor, utilizing the force of wind otherwise going to waste for this purpose.

The windmill, at the present day, is in a developed state, a practical success, ready and available for this new use at once. It awaits the electrical accumulator that is a thorough, practical success.

Just, now, and for some time past, the daily newspapers and many technical prints have been quite prolific in accounts which give an opposite impression, viz., as if the accumulator were the accomplished success, and the windmill at fault. The reverse is the fact, and I have thought it well to call prominent attention to it at this time.—*Stevens Indicator.*

FIG. 2.—MOTOR CAR ON THE FISHER ELECTRIC RAILWAY, DETROIT, MICH.

Electric Osmose and Electro-Capillary Action.*

BY R. SNOWDON.

Assuming with Clausius that in a case of electrolysis taking place in a liquid between, say, platinum electrodes, a polaric *bias* is put upon the otherwise chaotic evolutions of the molecules of the electrolyte by the E. M. F. of the current, it seems not unlikely that if the + and − ions be of unequal mass and the forces urging them in contrary directions be equal, *more work will be done upon the lighter radicles* than upon the heavier ones at each semi-revolution of the molecules of the Grotthuss chains (after each liberation of ions at the electrode surface), owing to the difference of inertia; and that the liquid will, in consequence, be urged towards that electrode towards which the lighter radicle is moving; also, that if a friction be introduced by placing a porous diaphragm or a series of porous diaphragms across the liquid, the back flow of the liquid *within the pores will* be retarded, and a difference of level on the two sides of each septum limited only by the strength of the current and the efficiency and thickness of the septum will be produced.

I have been led to think that this action may account for the phenomena of electric osmose and allied effects by the following considerations:

(1) Electric osmose is most marked in electrolytes whose molecules are of great relative unwieldiness and disparity of weight between their + and − components, as in the case of organic compounds.

(2) The ion moving towards the cathode (hydrogen in the majority of cases) is generally the lighter of the two ions, which accords with the rise of liquid around the cathode in general. In cases which would seem to contradict this hypothesis it may be that the elements *visibly* liberated at the anode are not the only ones which accompany the − ions on their journey and add to their inertia.

(3) That by reason of more work being done on the + ions than on the others, the cathode is more strongly bombarded than is the anode by the elements liberated against it, so that if either electrode be varnished on one face and floated, or made with vanes like Crookes' radiometer, or hung in the liquid, pendulum fashion, it will move to or fro with different force to the other in like circumstances, as in the capillary electrometer of Dewar.

(4) That the facts are not less consistent with the rather more difficult-to-grasp view that the active molecules of the Grotthuss chains, in performing their semi-revolutions from the positions in which they are formed at every change of partners, following the liberation of each pair of complemental irons at the ends of the chains, swing round their centres of mass; and even if their centres of bulk be coincident with their centres of mass it may be that the friction they exert against contiguous molecules in turning "right about face" is greater or less for one direction of reversal than for the other, owing to the different nature of the two halves of each molecule. Wherefore, the whole of the active molecules are impelled one way, and all the inactive molecules the other, with equal momentum, but not necessarily equal volumes,

*A communication to the Electrolysis Committee of the British Association, Manchester, 1887.

(5) That if the centres of bulk of the active molecules be displaced, their friction against neighboring molecules will, by their being disseminated in infinite number throughout the liquid, urge it as a whole in one direction just as a net of fine mesh would do.

(6) The apparent disagreement between this hypothesis and the fact that—at least when the electrodes are fixed—the + and — ions each undergo equal displacement in opposite directions, as evidenced by their being given off in equivalent quantities at the electrodes, will be seen to be *only apparent* when it is remembered that every time a + and — element is liberated at the ends of the Grotthuss chains, those chains are left one molecule too short, and that there is an abundance of molecules ready to fall into file all along the line, so that more will therefore fall in at that end from which the active molecules tend to be displaced.

A New Thermostat.

So much valuable property is now sought to be protected from fire by means of thermostats that the operation of the latter in order to be effective must of necessity be certain. The apparatus should not be liable to get out of order or to give false alarms. To provide a thermostat which shall fulfill all these conditions the National Automatic Fire Alarm Co., of this city, has adopted the thermostat shown in the accompanying engravings, in connection with its new automatic fire alarm system.

The illustrations, Figs. 1 and 2, exhibit the apparatus in perspective and section, respectively. The action of the thermostat is based upon the expansion of metal by heat. For this purpose there is employed a concave disc of zinc, rigidly confined around its edge in an unyielding frame of porcelain. Placed opposite the disc is a screw, the disc being one and the screw the other terminal of the circuit.

The inability of this disc to expand laterally or edgewise, when under the influence of a high temperature, causes it to bulge or warp in the direction of its convex side against the point of the contact screw, whenever the temperature reaches the danger limit. This contact closes the circuit and sends in the alarm. The screw can be readily adjusted to effect contact at any desired temperature.

The construction of the thermostat is such that the operative part is always well exposed to the influence of the surrounding atmosphere, and jarring and vibration have no effect upon it.

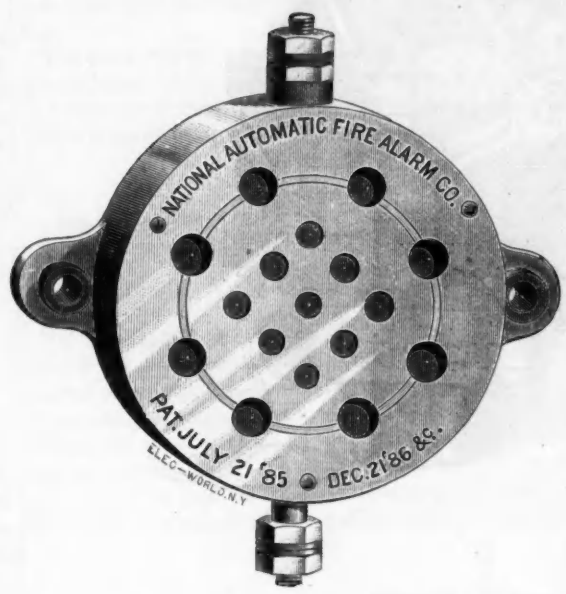


FIG. 1.—A NOVEL THERMOSTAT.

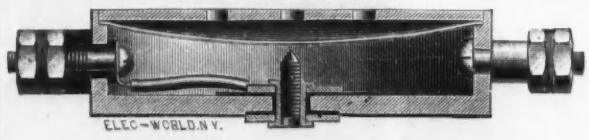


FIG. 2.—A NOVEL THERMOSTAT.

The Patent Reform Question Once More.

BY G. H. STOCKBRIDGE.

The bill to be introduced into the present Congress by the National Electric Light Association provides for the appointment of a commission, which shall hold office for one year and keep open session in Washington for at least thirty days to hear arguments and suggestions from all comers. The commission is further to "invite communications from all Justices of the Supreme Courts, and all Judges of the Circuit Courts and District Courts of the United States, and of the Supreme Court of the District of Columbia, and also from the Commissioner of Patents, and the Examiners-in-Chief, the Examiner of Interferences, and the other principal examiners of the Patent Office, on the subjects before the commission, and to receive and consider such communications as may be duly made to the commission in pursuance of such invitations." Finally, the commission has the duty of examining the patent laws of the United States and of other countries, and of drafting a revision of our present laws in the light of all the information thus obtained, the revision to be presented to the next Congress for its consideration. Such, in brief, are the powers and duties of the commission which Congress will soon be asked to create.

The National Electric Light Association has, further, through its counsel, indicated what direction its own ideas of reform in the patent system take. Mr. Steuart's able Institute paper, which has appeared in THE ELECTRICAL WORLD, sets forth its position clearly enough. It is to be presumed that, in case a commission is appointed, the association will strive to impress upon it the importance of the reforms which Mr. Steuart's paper advocates.

But there are some friends of our patent system who deprecate the proposed action of the association, both as to the bill for securing the appointment of a commission and, by implication, as to the proposed reforms. Such an one is Mr. E. C. Davidson, who, in an article in the WORLD of Jan. 21, puts the objections to the scheme in a forcible manner. I cannot bring myself to think, however, that his objections are well taken.

In the first place, Mr. Davidson objects that the action proposed represents the opinion of a comparatively small body of men, and intimates that the promoters of the bill may expect to meet opposition from many friends of patent protection. Now, it may well be asked what other course is open to those who would secure a reform of our patent laws.

I can think of but one other practical course that could at all avoid Mr. Davidson's objection and that would be a calling together of all who are interested in patent protection and framing in convention a form of revision which Congress should be called upon to enact. In such a convention, if it were conducted with perfect impartiality, we may suppose that all interests would be represented, and that every representative could express his views without restraint. But is not that precisely what the proposed bill will acomplish and in the most simple and effective way? One can well believe that, before a commission sitting for thirty days in Washington, with a postal connection extending over a full year, the great and the small, the *pro* and the *con*, will have a far better opportunity of being heard than in the most democratic convention. There is no man whose voice would carry weight in a convention of patent experts who cannot be heard with equal authority before a commission. In fact, to say that the action of the Electric Light Association is not representative, is to misconceive its intention, which is to provide a mode of procedure that shall make the final action as completely representative as possible.

Again, Mr. Davidson fears that, with a commission appointed and freedom of speech once granted, a flood of opposition to our patent system will pour in and endanger the structure on which it all depends. This, I fancy, is the true basis of most of the criticisms which the proposed bill has met. But, while it is true that a strong prejudice exists in the West and in our own rural districts against patents in general, yet it does seem to me that if the principle of protecting inventions cannot stand upon its record, it had better fall and be done with it. I cannot but think that publicity, open discussion, agitation are just what is wanted. It is the enemies of the patent system who strike in the dark.

When House bill 1,612 passed in 1877, it was put through without debate and, as Mr. Storrow said, "without any hearing before the Committee on Patents." "That bill," continued Mr. Storrow, "contained a great many clauses, which, the moment they became known to parties interested in patents,—rather by accident, for it had gone through the House very quietly—seemed to them to be destructive of the patent law; seemed substantially to take away all protection and all rights of inventors and patentees."

The bill coming to the Senate near the end of the session failed to pass and so came before the House again at the next session. At that time it was discussed before the House Committee on Patents, and the whole question of patent protection was canvassed as it has probably never been canvassed elsewhere. Men like Messrs. Storrow, Chauncey Smith, A. H. Walker and others traversed the whole field of inventions and manufactures and showed so far beyond a question the benefits of protection by patents that the bill was easily defeated on a vote of the full House.

The same questions and the same doubts concerning the benefits of patent monopolies which excite the fears of inventors here arose in England before the passage of the present law. They became at one time so powerful that "distinguished judges like Sir Roundell Palmer and Sir William Grove, leading politicians, including Earl Granville and Lord Derby, and experienced engineers like Sir William Armstrong and Sir John Hawkshaw, considered the evils of the patent laws to be so great that they were past remedy."

Inquiry and investigation soon showed, however, that "it would be dangerous to national interests to abolish patents for invention." The array of facts was too strong to be resisted, and the sentiment in England to-day is decidedly in favor of the system. The English position is fairly put by the Right Hon. Sir Lyon Playfair, from whom I have quoted above:

"Competition among nations is now a competition of intellect and not of local advantages. When the patent law was passed in 1624, Manchester was a hamlet surrounded by an undrained moss, and Birmingham was a village on the top of a bleak hill. The machinery which since then has added so largely to production has filled these towns with teeming populations, and they can only be supported by renewed inventions which will retain the superiority of England in the growing active competition of the world. Though previous to the patent laws important inventions were made, they are as nothing compared to the triumphs of industry in modern times. There is no leisure now to let invention flow on in a sluggish stream, as it would undoubtedly do, whether there were patent laws or not. Prizes in the form of rewards for successful venture must be offered to all who have inventive faculties, in order that there may be constant effort for improvement and progress. These prizes are the royalties for successful patents, and expediency is their justification."

This is a conclusion with which the most earnest friend of patents will agree in substance, and yet it was arrived at after just such a clearing of the atmosphere as a full discussion brings about.

By all means let all sides be heard. If there is any objection to be urged against the patent system let it be urged where there will be opportunity to refute it, unless it should happen to be a valid objection, in which case let it receive due attention when the final bill is framed.

I am compelled to indorse heartily the action of the National Electric Light Association. Much, I think, might be added to their suggestions of reform and some exceptions might be taken to them, but they have kindly undertaken to provide a tribunal where I, or anyone else who thinks as I do, can be heard in the way of supplementing their work or in opposition to it.

The Agitation for Government Telegraphs.

Dr. Norvin Green has recently expressed his opinion that though there may be as much agitation on the subject as formerly, there is not after all so much real sentiment in favor of the control of the telegraph system by the government as once existed. It is difficult to determine the truth of this opinion, but it does look as though the pressure brought to bear on Congress would not suffice to secure the change required. Meantime the subject is being thoroughly ventilated in the papers and periodicals, and has been treated so often that the arguments on both sides are by this time well nigh exhausted. One of the latest contributions to the discussion is that in the February *Forum*, by Senator Shelby M. Cullom, the author of one of the bills now before Congress. After going over the old familiar ground, Mr. Cullom says:

"I believe it would be wise to enact a law similar to the Inter-State Commerce act, so far as its provisions would apply to the telegraph business, placing that business under the supervision of the Inter-State Commerce Commission, in case Congress declines to establish a postal-telegraph system. This would afford the public some protection against unreasonable charges; but no system of mere regulation can accomplish the supreme object that should be aimed at in the establishment of a postal-telegraph system. That object should be the extension of telegraphic facilities to every place throughout the United States where there are post-offices, and at the lowest possible rates, irrespective of distance, so that the use of the telegraph may be within the means of the humblest citizen, just as the mail service now is. It is evident that this most desirable result can never be secured while the telegraph business is a private monopoly, and the rates are adjusted with a view to earning dividends upon an enormously inflated capitalization. It can be hoped for and secured only when the telegraph business of the country is conducted by the government as the mail service is managed; not with a view to raising revenue, but with a view to furnishing the public with the best possible facilities at the lowest cost at which the business can be made self-sustaining.

"The purchase of the existing lines is not seriously contemplated, because they cannot be acquired at anything like a fair valuation. The choice, therefore, lies between the contract system and the construction of new lines. The former plan follows the policy pursued in regard to the transportation of the mails, and avoids any considerable increase of the patronage of the department. This proposition is that the Postmaster-General shall be authorized to contract with the existing lines for the transmission of messages, which shall be received and delivered by the department, the compensation of the carriers and the charges for telegrams being first prescribed by Congress. Until this plan is tried we cannot know whether any, or how many, companies would make contracts at the low rates which Congress would establish. The construction plan would, within a few years, provide the government with a

better system than that now in existence, and it avoids the obstacles and delays that would be encountered in attempting to deal with the present companies. It is claimed that this plan would practically confiscate the existing telegraph properties by driving the companies out of the business, and would establish a government monopoly; but this objection comes with bad grace from the Western Union Company, which has itself driven more than fifty competing companies out of the business, and confiscated their properties at a fraction of their original cost. The Western Union has never been granted a monopoly of the telegraph business: it has simply acquired it, and has enjoyed enormous profits therefrom. It is not proposed to prevent the Western Union from carrying on its business, it will be free to compete with the government for the patronage of the public. And if it can furnish better service than can be given under a government system, as its advocates insist, it will be assured a profitable business.

"The objection most seriously urged against a postal telegraph is that its establishment would place too much power in the hands of the political party in control of the government, by adding enormously to the already large patronage of the Post-Office Department. This objection has not prevented the extension of the postal service hitherto, and will not in the future. The army of employés in the postal service is increasing constantly. The telegraph is properly a branch of the postal service, and there is no more reason to be alarmed at the increase of officials from the addition of a new branch to that system than from the extension of branches now in operation. Practically, there is less reason for alarm on this account in establishing a postal telegraph than in extending the present system. It requires special training and fitness for the work to be a telegraph operator, and these places could not be given as rewards for political service, as is the case in the post-offices. Besides, as was well said by the late Postmaster-General Howe:

"'The increase has doubtless been exaggerated. At a very large percentage of the offices the telegraph operator would not supplement the postmaster, but would supplant him, and that would result in giving to the administration of not a few offices men who have learned to do one thing in place of those who have never learned to do anything.'

"It is contrary to the genius of our institutions to multiply the functions of government unless some great gain is probable. I do not believe in a paternal form of government, but we are often obliged to choose between two evils, and I do not believe the American people will hesitate long in making a choice as between a government control and a private monopoly of the telegraph."

A pithy offset to this is found in the remarks of the New York *Tribune*, as follows:

"The Senate Post-Office Committee is now engaged in accumulating a great volume of useful information concerning the telegraph business here and elsewhere. It has learned that the experiment of a postal telegraph in England, where the conditions are much more favorable for such a scheme than they are here, has resulted in failure. With only one-sixth as many miles of line as are employed in America, covering an area only one twenty-fifth as great as the area of the American system, with only one-third as many offices and one-fifth as many employes earning salaries far lower than the salaries paid here, and doing a business almost as large as the business done by the American companies, there was yet a deficit of about $2,350,000 at the end of the last fiscal year which the British taxpayers had to make up. These figures tell with crushing force against the adoption of such a scheme in America. They show that the agency of the government is not cheap. It has not the same interest as private companies have to keep the balance on the right side of the profit and loss account. It does not appear that rates are cheaper in England than here. On the contrary, the average rate is higher and long distance rates are very much higher.

"There is no room to doubt that were the telegraph system handed right over to the government just as it stands today, it would be turned within a year from a good paying business, as managed by private persons, into a losing concern, loaded down with political "bummers" and doing its work in a hopelessly inefficient way. It could be decently obtained only at an enormous expense, for which there exists neither justification nor excuse."

A Portable Electric Light Plant.

At the instance of the Austrian Government, the Austrian Northwestern Railroad has had constructed for it, by Messrs. Siemens & Halske, a complete apparatus for electric illumination, which was recently tested in Vienna. The apparatus consists first of a portable engine and boiler, capable of working up to 12 h. p., and upon the same frame there is mounted a dynamo, as shown in

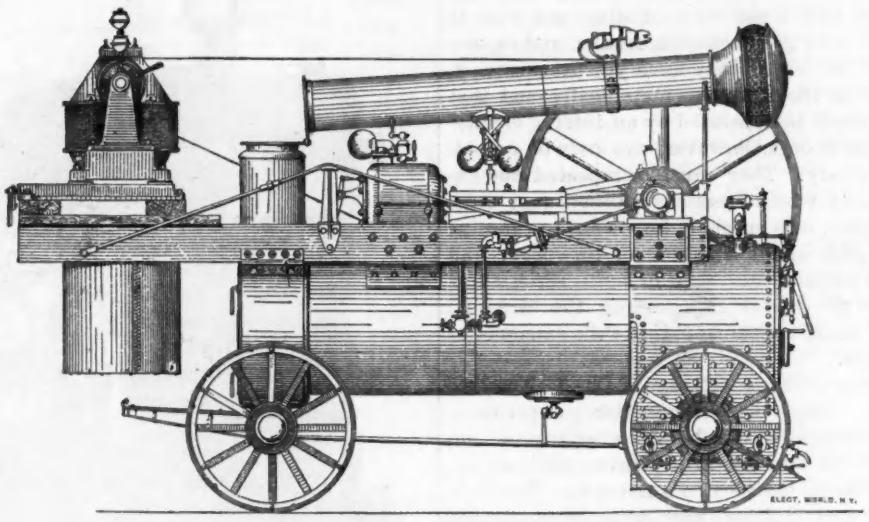


FIG. 1.—A PORTABLE ELECTRIC LIGHT PLANT.

Fig. 1. The dynamo chosen is one designed to give a constant potential of 110 volts and a current capacity of 50 ampères. In order to protect the whole generating plant from the influence of the weather, it is arranged so that it can be completely covered by a tent. Insulators, attached to the smoke stack, are designed to carry the circuit from the machine to the wagon accompanying it. The total weight of the generating plant is 6,320 kilogrammes, or a little over 6 tons. The supply wagon, which accompanies the outfit, shown in section in Fig. 2, contains all the material for the installation of the lighting apparatus. In the latter there is comprised eight complete arc lamps, with inclosing shades, designed for 9 ampères, the switch-board with a sufficient supply of poles, wires and also a small workshop outfit. There is also contained in the same, six incandescent lamps and holders and the usual dynamo supplies, such as brushes, etc.

The entire weight of the loaded wagon amounts to 3,800 kilogrammes, or nearly 4 tons. The poles are provided with a special base attachment, so that they can be set in the ground rapidly and firmly. In one case the attachment consists of a shoe of iron, pointed, so that it can be easily pressed into the ground, and the pole is then fastened to that as a base. In the other, the base consists of an arrangement provided with a screw, so that it can be screwed into the ground in the same way as the iron piles employed in foundations in sand.

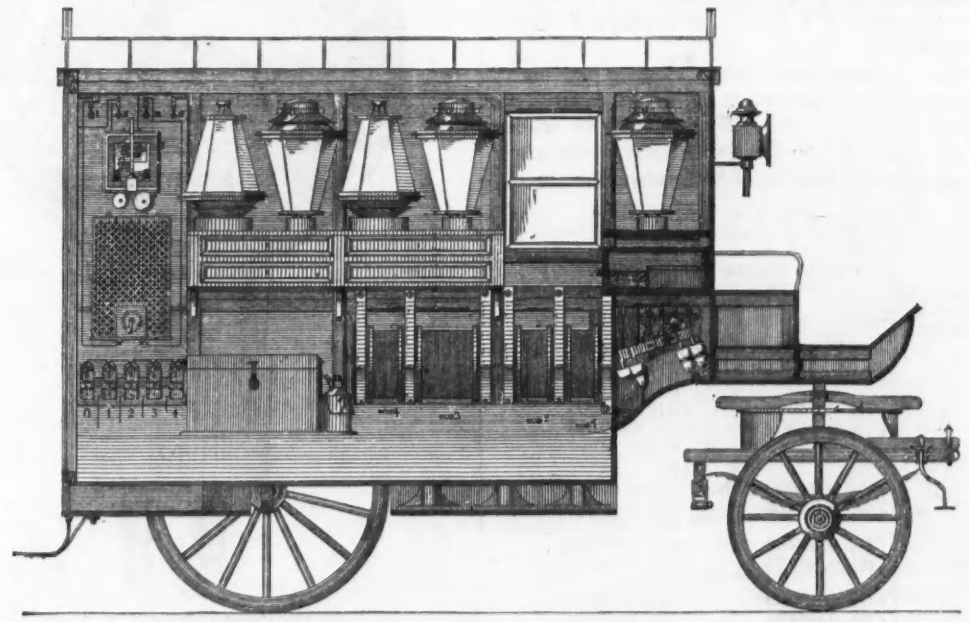


FIG. 2.—A PORTABLE ELECTRIC LIGHT PLANT.

Dansville, N. Y.—A Brush incandescent electric light plant will be placed in the Whiteman Paper Mills, at Dansville. The lights will be as follows: Fifty-six of 16 candle-power and two of 32 candle-power each. Heretofore a disadvantage in paper mill lighting has existed, owing to the action of acids and steam evolved in the different processes, and which operated to the disadvantage of electric lights in paper mills. Safety fuses are placed in the system wherever there is a possibility of their being needed. The paragon wire has been used, which is warranted acid and steam proof.—*Mfrs. Gaz.*

Experiments on the Possible Electrolytic Decomposition of Certain Alloys.*

BY PROF. W. C. ROBERTS-AUSTEN, F. R. S.

The original suggestions framed for the guidance of the committee provided for an examination of the question whether molten alloys would conduct electrolytically, and during the year 1886 various experiments were made in the Mint laboratory, the results of which were in all cases negative, but were useful as indicating the method of working which appeared to afford the best prospect of success. The selection of a suitable alloy is by no means easy. It seemed well to begin by employing lead-gold and lead-silver alloys for the following reasons: Matthiessen † has shown that these alloys, when considered from the point of view of their electrical resistance, belong to a class described by him as "solidified solutions of one metal in the allotropic modification of another."

Some work has already been done on the alloys considered as solutions of the precious metals in lead. I have already submitted to the British Association preliminary results on the diffusion of silver and of gold in molten lead,‡ and some unpublished experiments of my own have shown that certain silver-lead alloys when poured in spherical molds, capable of holding about 2·6 kilogrammes of lead, set as a whole without exhibiting any tendency to the re-arrangement of the constituent metals known as "liquation"—that is, the constituent metals do not readily fall out of solution. Such alloys are those which contain less than 3 per cent. of silver. The alloy containing 51.06 per cent. of silver to which the formulas Ag_2Pb may be assigned, also sets as a whole without re-arrangement of its constituents. Guthrie, in an admirable research, interrupted by his lamented death, has shown§ that a "eutectic" alloy of silver and lead probably contains less than 15 per cent. of silver—that is, it is the alloy of the lead-silver series which has "a minimum temperature of liquefaction, . . . a temperature lower than that given by any other proportion," and he points out that such eutectic alloys are "neither atomic nor molecular" in constitution. The curves representing the electrical resistance of solid lead-silver and lead-gold alloys are not continuous, and do not reveal the existence of any special alloy, differing widely in resistance and in physical properties from the rest of the series. In the case of the copper-tin series of alloys, investigated by Matthiessen,‖ in 1860, by myself in 1879,¶ and by Dr. Lodge** in the same year, the alloys $SnCu_3$ and $SnCu_4$ stand quite apart from the rest of the copper-tin series both in color, lustre and electrical resistance.

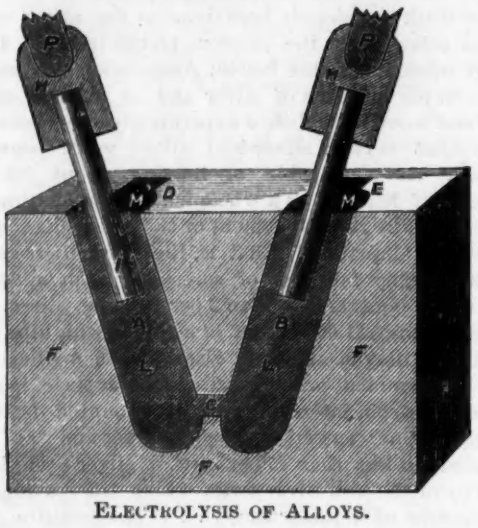
It will be specially important to ascertain whether the passage of a strong current will enable the constituents of the copper-tin series of alloys to be separated; but, unfortunately, the alloys of these metals have high melting points, and as the alloys have to be kept molten by the external application of heat during the passage of the current, the difficulties of manipulation are greatly increased.

I considered, therefore, that it would be better to begin already stated, much is known concerning their behavior as solutions. One additional advantage in the employment of these alloys is presented by the readiness with which variations in their composition may be determined. This is a point of some importance, for if, as Dr. Gladstone has already suggested, the results of passing the current through the molten alloys were only very slight changes in composition, the errors of analysis might overshadow the change. In the case, however, of the lead-gold and the lead-silver alloys, the method of assay by cupellation enables very minute changes in composition to be detect-

* Read at the British Association, Manchester, as part of the Report of the Electrolysis Committee.
† *Phil. Trans.*, 1860, p. 161.
‡ Report for 1884, p. 675.
§ "On Eutexia," *Phil. Mag.*, 1884, Vol. I., p. 462.
‖ *Phil. Trans.*, 1860, p. 85.
¶ *Phil. Mag.*, 1879, Vol. II., p. 57.
** *Ibid.*, 1879, Vol. II., p. 554.

with the lead-silver and lead-gold series, which have comparatively low melting points, and of which, as I have ed, and the amount of change can be determined with great readiness and accuracy.

The preliminary experiments need not be described at length; it is only necessary to state that fire-brick U′tubes, about five millimetres in section were employed, and that in them the fluid alloy was kept molten by the external application of heat. The electrodes first used were stout iron wire terminals of a forty pint cell Grove battery; the passage of the current was maintained for thirty minutes, and portions of metal were tilted out from either end of the tube. These samples were then assayed, and it was found that no variation whatever had been produced by the current. The passage of the current was not maintained during the time the samples were taken, and, as diffusion would probably rapidly restore the uniformity of



ELECTROLYSIS OF ALLOYS.

the alloy, if the current did produce any change, care was taken in subsequent experiments to remedy this defect in the manipulation.

Dr. Lodge, in a letter to me dated April 5, 1886, asked whether it was possible to employ tubes one millimetre in section. I, therefore, broke off the bowls of two tobacco pipes, leaving about ten millimetres of stem attached to each of the bowls, which were then filled with the lead-silver alloy (containing 2 per cent. of silver) by placing them in a bath of the fused alloy and allowing the metal to enter the bowls through the stems. A current from the forty-cell battery was then passed for twenty minutes, when both bowls were rapidly withdrawn. The contents proved on assay to be identical in composition. The ends of the stems while in the bath were about five millimetres apart.

The nature of the subsequent experiments is best shown by the sections of the fire-brick receptacles submitted to the committee and by the following diagram :

The reference letters are : *P P*, cables from battery ; *H H*, copper holders; *M M*, cavity for withdrawal of sample ; *I I*$_1$ wrought-iron rods ; *F F F*, soft fire-brick; *L L*, silver-lead or gold-lead alloy.

The secondary batteries used for the electric lighting of the Mint were placed at my disposal by Mr. R. A. Hill, the superintendent of the operative department, to whose assistance I am much indebted. The weight of the alloy used in the experiments was about 500 grammes.

TABLE A.

Samples.	Time from starting current.	Weight in grammes of gold obtained from two grammes of the alloy.	
		Positive side.	Negative side.
1	0′	(1) 0.04023 (2) 0.04007	(1) 0.03905 (2) 0.03855
2	10′	(1) 0.04029 highest (2) 0.04026	(1) 0.03954 (2) 0.03920 lowest
3	23′	(1) 0.02988 (2) 0.03973	(1) 0.03944 (2) 0.04010
4	40′	(1) 0.03980 (2) 0.03966	(1) 0.04009 (2) 0.04010
	Totals...	0.23962	0.23847*
5	45′	(1) 0.03917 (2) 0.04016	(1) 0.03926 (2) 0.04051

* Total difference + 0.00115 grm.

With the appliance arranged as shown in the diagram, the momentary application of twelve cells (supplied by the Electrical Storage Company) projected the metal (a 5 per cent. lead-silver alloy) from the fire-brick receptacle, while ten cells rapidly heated the iron terminals to redness and fused the lead "lugs" of the cells. It was not found practicable to employ more than four cells for any experiment which lasted more than a few minutes, and in no case did the strength of the current exceed 300 ampères.

The following experiment with a gold-lead alloy containing about 2 per cent. of gold is given as showing the method of working:—Before melting the alloy two grammes yielded on assay 0.03981 gramme (or 1.99 per cent.) of gold; after the fusion had taken place the samples taken gave on assay the results shown in Table A. They were withdrawn from the cavities marked *M, M*, on the diagram at the periods indicated in the table. The current used was from three of the secondary cells connected in series.

For the purpose of controlling the results, samples 1 and 5 were taken from the molten metal while no current was passing, and were assayed with the rest. It will be seen from the above table that the difference varied from a minimum of one ten-thousandth as deduced from the total difference found on assaying samples 2 to 4, to a maximum of five ten-thousandths presented by sample 2. The alloys of lead with 2 per cent. of silver and with 51 per cent. of silver also gave negative results, and experiments as a whole, so far as they have yet been carried, tend to show that an alloy conducts metallically, and that its constituents cannot be separated by an intense electric current. The experiments, however, can only be considered to be preliminary. They must be repeated and extended, and alloys of which arsenic is a constituent must be tried; and further, it is specially important to examine the behavior of such alloys as those of tin-copper and bismuth-gold, as certain members of both series show marked points on the curves representing the electrical resistance which would appear to indicate the existence of definite compounds.

In the discussion which followed, Dr. GLADSTONE said that the suggestion that this experiment could be made better by means of a change of resistance attributed to him by Prof. Austen really emanated from Mr. Hibbert, the speaker's assistant. Mr. Hibbert had recently been making experiments by employing fusible metal which melted under 100 degrees of temperature, with a result similar to that brought under the notice of the section by Prof. Austen—that was to say absolutely *nil*. There seemed to be no transference whatever of the metal from one point to the other. He and Mr: Hibbert agreed that the investigations had been carried far enough to warrant them in saying that the result was a negative one.

Prof. S. P. THOMPSON: I wish to ask Prof. Wiedemann whether the alloys used in his experiments belonged to that class of alloys the formation of which is accompanied by an evolution of heat or not ?

Prof. WIEDEMANN: I think not.

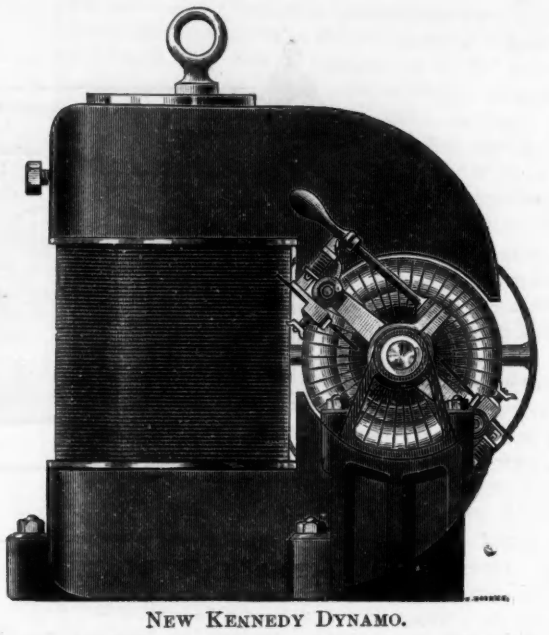
Sir WM. THOMSON: I think that the paper of Prof.

THE INCANDESCENT LAMP "FREAK."

Austen speaks for itself. The expressions of opinion that Dr. Gladstone and Prof. Wiedemann have given confirm the result, and I think that this discovery has been quite settled and made known to the world to-day for the first time. It is a most valuable and important contribution to our knowledge on the subject.

Kennedy's Compound Wound Dynamo.

The accompanying engraving illustrates a new machine recently introduced by Mr. Rankin Kennedy, of the Woodside Electric Works, Glasgow, Scotland, to whom we are indebted for the illustration, etc. As will be seen, the field magnet is made of three pieces, with only one field bobbin. The core of the bobbin is made of hammered scrap iron, and measures 10 inches in diameter and 14 inches in length ; the pole-pieces are of soft cast iron, and are of much greater cross-section than the core of the bobbin. This construction has the advantage of simplicity, combined with compactness and low magnetic resistance. The armature is built of charcoal iron discs, and the core is turned true, outside and inside, and mounted on metal spokes on a steel shaft ; the outsides of the armature are usually turned up true on the shaft. The armature core of this machine is 12 inches long, 10 inches in diameter outside, and 6 inches inside diameter, the depth of core being thus 2 inches; the armature is wound with flat wire 5 mm. by 3.5 mm., one layer outside. The current allowed for this armature running constantly for long runs is 90 ampères. The commutator is made of solid-drawn copper sections, insulated with mica, and is of large size. The brushes are adjustable in all directions,



NEW KENNEDY DYNAMO.

and the pressure on the commutator is adjusted by springs. The brushes require a slight adjustment for varying loads, but at a speed of about 900 revolutions this machine gives 102 volts at the terminals.

According to the tests of Prof. Andrew Jamieson, the dynamo gave an output of 10,850 watts, or 108.5 ampères and 100 volts at 620 revolutions per minute. The peripheral speed of the armature is 1,900 feet per minute. The following are the data of construction and operation of the machine:

Resistance of armature, warm.....	= .04 ohm.
Resistance of magnet shunt, warm.....	= 20 ohms.
Resistance of magnet main coil, warm..... ..	= .03 ohm.
Current in working circuit..	= 108.5 ampères.
Current in shunt magnet coils	= 5 ampères.
Difference of potential at dynamo terminal. .	= 100 volts.
Difference of potential at brushes	= 103 volts.
Speed in revolutions per minute.....	= 620.
Temperature of air..	= 60° F.
Highest temperature of armature	= 140° F.
Highest temperature of magnet coils.....	= 125° F.

The Incandescent Lamp Freak.

BY EDWARD A. COLBY.

Although Mr. Blodgett's theory of the origin and order of conditions producing the peculiar collapse of a lamp, illustrated in a recent issue of this journal, may be correct, yet, as he invites criticism, I offer another explanation based upon observation of kindred freaks in both the embryo and developed state.

Assuming that the illustration gives the relative positions and dimensions of the conical depression, carbon, stubs and conducting wires with approximate correctness, it may be noted : (*a*) That the mouth of the funnel has a diameter nearly equal to the distance between the terminals of the ruptured circuit. (*b*) That the axis of the funnel is but a trifle above the upper edge of the stubs and, therefore, the centre of depression is not only opposite a portion of the incandescent carbon having less than the maximum temperature, but the perimeter of the intact bulb measured along this axis is at a maximum distance from the heating agent. (*c*) That the funnel and incandescent part of the carbon are not symmetrically placed. (*d*) That the funnel is symmetrically placed with reference to the terminals of the ruptured circuit, the prolongation of the funnel's axis nearly bisecting the line joining these terminals. (*e*) That the terminals of the ruptured circuit are so far apart as to preclude the maintenance of an arc for a sufficient time after the rupture of the bulb to disintegrate the conductors to the extent shown ; assuming that the carbon was thoroughly disintegrated, as no mention is made of tangible fragments.

To produce incipient depression of the bulb would require a maximum temperature of the glass per sectional unit at the yielding point. This condition might obtain with the incandescent carbon intact, as Mr. Blodgett states, if the section of the glass on the axis of the funnel depression was very thin; but the funnel formed would probably have a smaller area than is shown, and, in any event, it would be symmetrically placed with reference to the heating agent.

The following would seem to be a plausible relation of causes and effects:

(1.) Rupture of the carbon and the establishment of an arc on or near to the axis of the subsequently formed depression.

(2.) Radiation of heat from this centre of maximum temperature along the normals to the plane of the electrodes, producing softening and yielding of the perimeter of the bulb at the terminus of the shortest normal.

(3.) Gradual enlargement and constant play of the arc between the disintegrating terminals, effecting a softening of the glass over a larger area with a more rapid elongation of the funnel. Deposition of the disintegrating carbon upon the interior walls of the bulb up to the time when the arc was interrupted by the entrance of air through the ruptured bulb.

Freaks of this character have, in my experience, been confined to lamps having carbons sufficiently rigid to retain the terminals of the ruptured carbon in nearly the

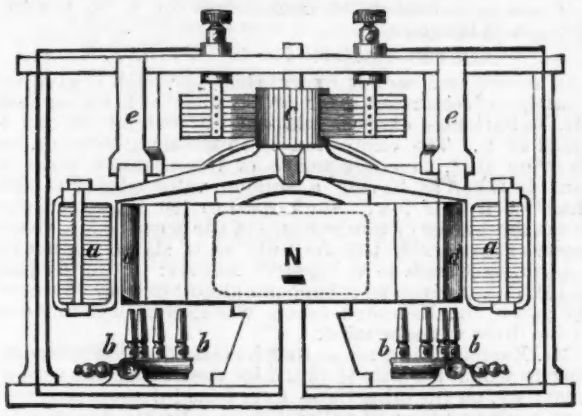


FIG. 1.—MENGES' PYROMAGNETIC GENERATOR.

same plane, and thus aid in the formation and maintenance of an arc within the vacuous bulb until interrupted by the entrance of air, or the complete destruction of the electrodes. While constructing experimental lamps in Mr. Weston's laboratory, I had occasion to investigate, during a period of several years, numerous freaks, and not a few of this type. If my memory is not at fault, in every case of conical depression of the bulb, having a mouth exceeding a quarter of an inch in diameter, there existed good evidence (one actual observation) of the formation and maintenance of an arc previous to the formation of the funnel and rupture of the bulb.

Converting a Holtz Machine into a Motor.

The students of Cornell University are being treated to a most excellent series of lectures on electricity and magnetism by Professor Nichols, in charge of the department of physics. Professsor Nichols apparently spares no pains in preparing his lectures; they are profusely illustrated with interesting and often brilliant experiments, illustrating theory, or serving to show its practical applications. The lectures of the present term are more especially intended for the sophomore class, though largely attended by members of all the other classes in the University. The opening lectures have been devoted to the elementary principles governing the laws of static electricity, with descriptions and experimental use of detecting and measuring instruments.

As an incontestable proof that electricity is a form of energy, as much so in the form of frictional or static elec-

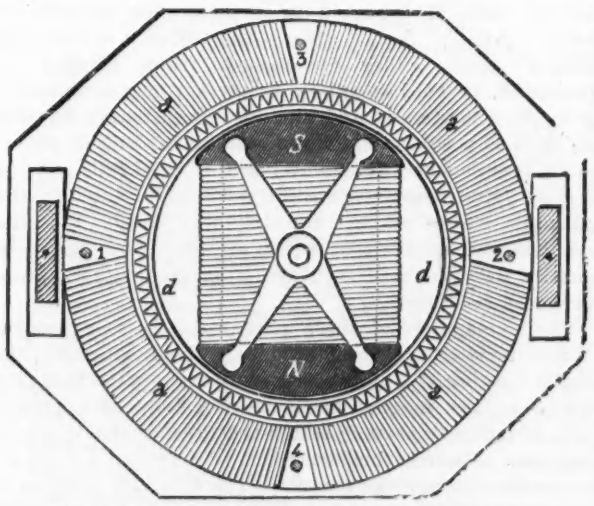


FIG 2.—MENGES' PYROMAGNETIC GENERATOR.

tricity as when obtained by chemical decomposition in a voltaic cell, Professor Nichols recently performed the striking and rather uncommon experiment of reversing the action of an ordinary Holtz machine and converting it into a motor. The machine employed was a small one with a single revolving glass plate, and the charge was obtained from the large laboratory Holtz machine driven by a water motor from the lecture room table. The current charge was conveyed to one of the brush conductors by a simple wire connection, and, after traversing the plate, was led to earth from the opposite collector. The glass plate started of itself, and quickly developed a speed equal to that when driven by hand.

Published accounts of the reversibility of the statical electrical machine are rare, though Professor Anthony, while at Cornell, exhibited it before his classes for years. It would be interesting to determine the electrical and mechanical efficiencies of the two machines in their relation to each other as generator and motor.

An Important Decision as to Telephone Rates at Rochester, N. Y.

The subscribers to the Bell Telephone Company's service in Rochester are not a little surprised at the result in the test suit that came off before Justice Rumsey in the Circuit Court in that city last week. The point at issue was whether the company could collect rents for instruments after the strike became general, and the subscribers whose contracts had not run out alleged that the service was worth nothing to them, owing to the fact that so few people used the telephones as to reduce the number in active operation from 1,200 to about 200. This assertion was made by many of the strikers, notwithstanding that they themselves were refusing to answer the calls of their instruments as well as to send messages by them. Justice Rumsey has decided the point in favor of the Bell Company, refusing to allow its suit against George H. Worrall & Co. to recover for back rent to go to the jury, but ordered a judgment of $66.87 for the company, which includes interest.

The amount of money involved in the suit is small, but as the suit was tried as a test case the issue is of the greatest importance. In directing a verdict Judge Rumsey said the contract into which the telephone company and the defendants had entered was decidedly one-sided, but with that feature of it he had nothing to do. Under that contract there was no guarantee that the number of subscribers would be increased or would not be diminished, or, in fact, kept up at all. It did not guarantee that the company would continue in business in the future except to complete its contracts. The company had just as full a right to close up its business as a grocer, after completing its contracts. There was no evidence to show that the change from the flat rate to the toll system or that the prices under the toll plan were exorbitant or unreasonable. The only restriction in the most extreme view of the case that would be imposed on the company was that it could not willfully make such rates and conditions as would cause the public to be excluded from the

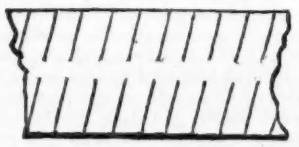


FIG. 3.—MENGES' PYROMAGNETIC GERERATOR.

right to use the system. Such an act must be of a willful character and for the purpose of exclusion. If the company raised the rates, and if it were a mere error of judgment to the best means of conducting business, that would be a mere mistake, and would not constitute a willful act which could be restricted.

The Menges Thermo-Magnetic Generator and Motor.

We have received from M. Menges, of the Hague, Holland, says the London *Electrician*, a most interesting description of an apparatus on which he has been at work for some time past, with the object of generating electricity by the direct conversion of heat, or, as it might be more accurately described, by a more direct conversion than that of an ordinary dynamo. M. Menges' apparatus depends, like that of Edison, upon the fact that the magnetic metals lose their magnetic permeability at a certain temperature.

It differs greatly, however, from its predecessors in important points, especially in the fact that it does not require the aid of anv external source of motive power.

In Edison's pyro-magnetic dynamo it will be remembered that it is necessary to provide some small amount of motive power from an extraneous source in order to revolve the shield by which the heat is alternately directed on one half or the other of the armature cores. M. Menges' apparatus is, on the contrary, wholly automatic.

The following is a free translation of the description furnished by the inventor. In attempting to employ the thermo-magnetic properties of iron or nickel in the construction of machines for the generation of electricity upon an industrial scale, we are met with the difficulty that the heating and cooling of large masses of metal not only involves great loss of heat but also requires much time; hence to obtain a useful effect of any importance it would appear necessary to employ machines of dimensions altogether impracticable. By the device and method of construction now to be explained this difficulty has, however, been completely overcome.

The action of a magnetic pole diminishes so rapidly with the increase of distance that it may suffice to remove the armature to a distance relatively small compared with its own dimensions, or with those of the magnet, in order to reduce the action to a negligible value. But if, as in the accompanying illustrations, the magnet *N S* and the armature *a* being at a certain distance, we bring between them a piece of iron or nickel *d*, then the magnetic force upon *a* is immediately and very considerably increased. In modern terms, the resistance of the magnetic circuit has been reduced by the introduction of a better magnetic conductor, and the number of lines of force passing through *a* is proportionately increased. The mass of the piece *d* may, moreover, be relatively small, compared with that of *N S* and *a*. If *d* be again withdrawn the magnetic resistance is increased, and the lines through *a* are again a minimum.

Now it is evident that we can also obtain the same effect by sufficiently heating or cooling the intermediate piece *d*, and, again, with a broad field, we can alter the distribu-

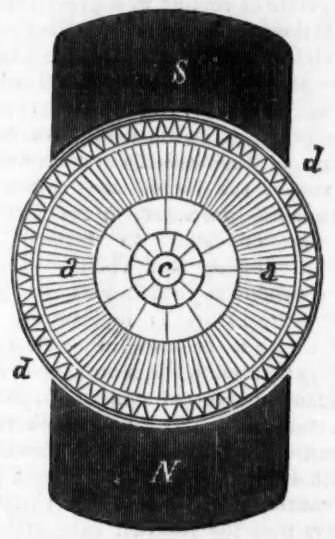


FIG. 4.—MENGES' PYROMAGNETIC GENERATOR.

tion of the lines at will by heating or cooling one side of this piece or the other. For this reason we will call the piece, *d*, the thermo-magnetic distributor, or, briefly, the distributor.

We will now describe the manner in which this principle has been realized in the practical construction of both a thermo-magnetic generator and motor.

Fig. 1 shows an elevation and part section of one of the arrangements employed. Fig. 2 is a plan of the same machine (in the latter the ring *a a* appearing on a higher plane than it actually occupies). *N S* is an electro-magnet, *a a* the armature, wound as a Gramme ring, and fixed to a frame with four arms, which can turn freely upon a pivot midway between the poles. The cross arms of the frame are attached at 1, 2, 3, 4, Fig. 2. Between the magnets and the armature is placed the distributor *d d*, where it occupies an annular space open above and below. Both the magnets and the armature are coated with mica, or some other non-conductor of heat and electricity on the sides facing the distributor. The distributor is attached to and supported by the cross-arms, so that it turns with the armature.

The distributor is composed of a ribbon of iron or nickel bent into a continuous zig-zag. This form has the advantage of presenting, in the cool part of the distributor, an almost direct path for the lines of force between the poles

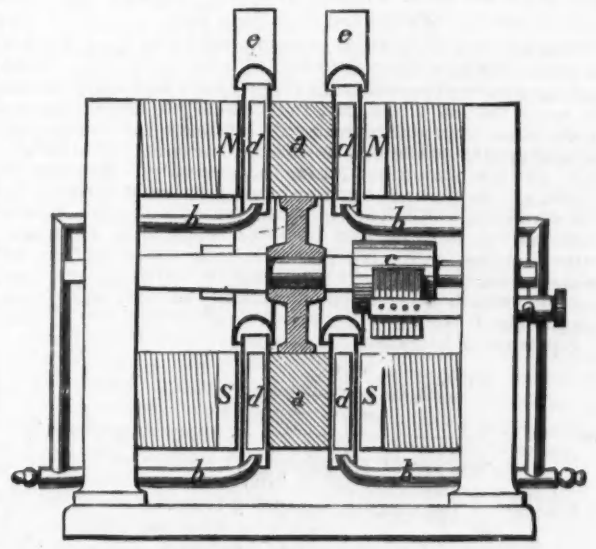


FIG. 5.—MENGES' PYROMAGNETIC GENERATOR.

and the armature, thus diminishing the magnetic resistance as far as possible. At the same time the Foucault currents are minimized. To the same end it is useful to slit the ribbon, as in Fig. 3; this also facilitates the folding into zig-zags.

The distributor is heated at two opposite points on a diameter by the burners *b b*, above which are the chimneys *e e*. The cooling of the alternate section is aided by the circulation of cold air, which is effected by means of the draught in the chimneys *e e*. At the points of lowest temperature a jet of air or water is maintained. The cross-arms are insulated with mica or asbestos at the points where they extend from the armature to the distributor.

It will now be evident that while the distributor is entirely cool many of the lines of force pass from *N* to *S* without entering the armature core; but if heat is applied

at the points 1 and 2 in the figure, so as to increase the magnetic resistance at these points, then a great portion of the lines will leave the distributor and pass through the armature core. Under these conditions, so long as heat is applied at two points equidistant from *N* and *S*, we might, if we so pleased, cause the armature to be rotated by an external source of power, and we should then have an E. M. F. generated in the armature coils—that is to say, the machine would work as an ordinary dynamo, and the power expended in driving the armature would be proportionate to the output.

Suppose next that the points of heating, and with them the alternate points of cooling 90 degrees apart, are shifted round about 45 degrees, so that the two hot regions are no longer symmetrically situated with respect to each pole of the field. The distribution of the magnetization has therefore become unsymmetrical, and the iron core is no longer in equilibrium in the magnetic field. We have, in fact, the conditions of Schwedoff's experiment upon a larger scale, and if the forces are sufficient to overcome the frictional resistance a rotation of the ring ensues in the endeavor to restore equilibrium. The regions of heating and cooling being fixed in space, this rotation is continuous so long as the difference of temperature is maintained. The ring in rotating carries with it the armature coils, and of course an E. M. F. is generated in the same way as if the motive power came from an external source. In this respect the machine therefore resembles a motor-generator, and the rotation is entirely automatic. The armature coils are connected with a commutator in the usual way, and the field may, of course, be excited either in shunt or in series. M. Menges says that the residual magnetization is sufficient in his machine to start the rotation by itself. When the machine is to be used as a motor it is evident that the windings on the armature core need only be sufficient to supply current to excite the field, or by the use of permanent magnets they may be dispensed with altogether.

M. Menges has further designed a large number of variations on the original type, varying the arrangement of the several parts, and employing armatures and fields of many different types, such as are already in use for dynamos. In Fig. 4 a machine is represented in which the field is external to the armature. In Fig. 5 we have a thermo-magnetic generator, which corresponds to the disc machine in dynamos. Similar parts are indicated by the same letters in each of these figures, so that no further detailed description is necessary.

In another modification M. Menges proposes to rotate the burners and leave the armature and distributor at rest. But in this case it is evident that the E. M. F. produced would be much less, because the magnetization of the core would only undergo a variation of intensity, and would nowhere be reversed, except, perhaps, just in front of the poles. In machines modeled on the Brush type it is evident that the distributor need not be continuous. Enough has, however, been said to indicate the extent of the field upon which the principle may be applied.

Portable Voltmeters for Measuring Alternating Potential Differences.*

BY W. E. AYRTON AND JOHN PERRY.

(*Continued from page 44.*)

This result was obtained experimentally by Prof. Forbes in 1884,† but he appeared to regard it as a result that would not have been expected from experiments previously made on much thicker wires. Mr. Preece also published results,‡ in the same year, of experiments made on fine wires, and he also speaks of the results of experiments "contradicting" the law which he obtains theoretically. Whereas it appears to us that the current having to vary directly as the diameter, and not as the diameter raised to the power three halves, in order that *very fine* wires may be maintained at the same temperature, is in entire conformity with the true law of the loss of heat by radiation and convection, which was published certainly as early as 20 years ago by Mr. Box.

Equation (5) becomes

$$\theta = \frac{V^2 d}{4 l_o^2 \varepsilon \rho_o (1 + k\theta)}$$

or $$\theta = \frac{V^2 d}{4 l_o^2 \varepsilon \rho_o \left(1 + k \frac{V^2 d}{4 l_o^2 \varepsilon \rho_o}\right)}, \text{ approximately.} \quad (5)$$

One law of the magnifying spring is that

$$\varphi = \frac{s}{r}(y - y_o) \quad (6)$$

where φ is the rotation of the pointer in radians, s is a number depending upon the material of which the spring is made, and has a value about 1 radian for phosphor bronze and r is the radius of the spring.§

Substituting for y from (6) in (2), we have, as

$$y = \frac{r\varphi}{s} + y_o,$$

$$\frac{r^2}{s^2}\varphi^2 + 2\frac{r}{s}y_o\varphi = \tfrac{1}{4} l_o^2 a \frac{V^2 d}{4 l_o^2 \varepsilon \rho_o \left(1 + k \frac{V^2 d}{4 l_o^2 \varepsilon \rho_o}\right)}.$$

or $$\varphi^2 + 2\frac{s}{r}\, y\varphi = \frac{s^2}{r^2}\frac{d\,a}{8\varepsilon\rho_o}\,\frac{V^2}{1 + \frac{k d}{l^2 \varepsilon \rho_o} V^2} \quad (7)$$

or, if $$A = \frac{s^2}{r^2}\frac{d\,a}{8\varepsilon\rho_o}, \text{ and } B = \frac{k d}{4 l_o^2 \varepsilon \rho_o},$$

and if $\frac{s}{r} y_o$ be called φ_o, then

$$\varphi^2 + 2\varphi_o\varphi = \frac{A V^2}{1 + B V^2} \quad (8)$$

and hence $$\varphi = \varphi_o \left\{ -1 + \sqrt{1 + \frac{A}{\varphi_o^2}\frac{V^2}{1 + B V^2}} \right\} \quad (9)$$

There are discrepancies in this result, due to—

1. Our assuming (1). But it will be found that the error due to this assumption is not large for the usual temperatures of the instrument when platinum-silver wire is employed. See F—"Correction for Temperature."

2. Our assuming ε to be independent of θ. If ε is not constant, the law (9) alters in shape. As we never use (9) for the purpose of graduating, but merely to give us some approximate knowledge of a general law, this will not affect in any way the accuracy of the instrument.

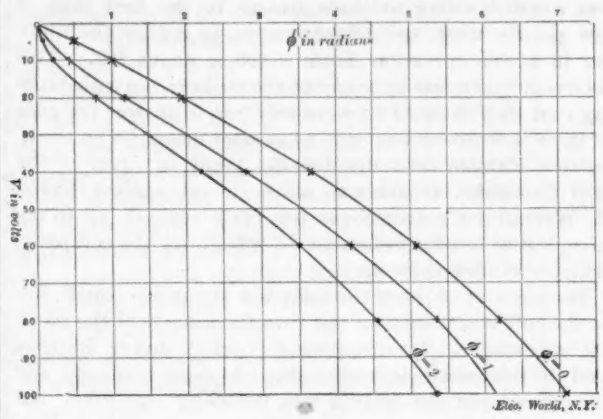


FIG. 11.

3. We have not taken into account the fact that time is needed to attain the state of equilibrium indicated by (4), so that θ might be expected to rise higher on first starting the current than its true steady value; but we find experimentally that this time is quite inappreciable with a *very fine* wire placed *horizontally*.

4. Our having neglected small changes in y due to the tensile strain in the wire. It can be proved that these are unimportant, except when y_o is smaller than we are ever able to have it in our instruments.

5. Our having dealt in certain small quantities as if they were indefinitely small.

B is found to be small in our instruments, and when y_o is very small it is obvious that the deflection φ of the pointer is very nearly proportional to V, the potential difference. When y_o is not small, the readings increase at first in proportion to the square of the volts, and then become more nearly proportional to the volts. In fact, the divisions for volts of the scale of the instrument get rapidly greater for small readings; then, as the readings become higher, the divisions become equal to one another; and if the range is high enough they become somewhat smaller again, due to the change of resistance with temperature making its effects felt.

For the sake of illustration we have drawn the three curves shown in Fig. 11, taking

$$A = \cdot 01,$$

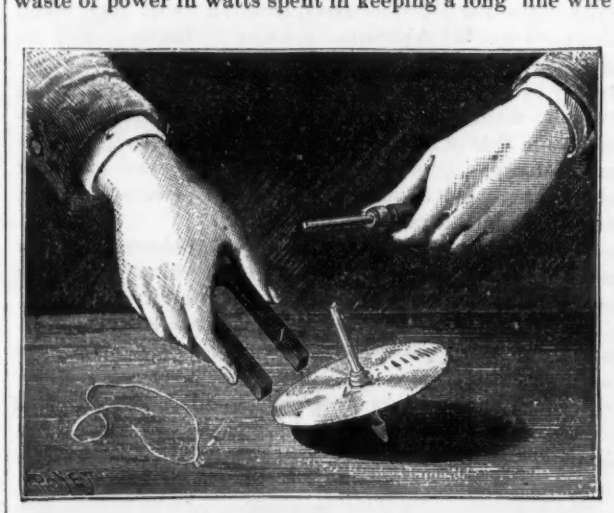
and $$B = .0001,$$

and the values 0, 1 and 2 for φ_o.

If such a spring is used that $\frac{s}{r} = 1$, then φ_o is y_o.

B.—WASTE OF POWER IN THE VOLTMETER.

From the equations previously given, it follows that the waste of power in watts spent in keeping a long fine wire



AN INDUCTION TOP.

l_o centimeters in length θ° C. above the temperature of the surrounding space equals

$$0.0008848\ \pi\ l_o\ \theta,$$

a value which depends only on the length of the wire and on the temperature to which it is raised above the temperature of the case, but not at all on the diameter of the wire. This result is confirmed by the experiments recently made by Mr. Evershed, who has found that about 36 watts are required to keep a wire 3,600 mm. long at a temperature of about 180° C. above the temperature of the case, whether the wire be 0.038 mm. or 0.0635 mm. or 0.0889 mm. (*i.e.*, 1.5 or 2.5 or 3.5 mils.) in diameter. Substituting 360 centimetres for l_o in the above expression, and 180° C. for θ, the value becomes 180.2 watts. This is more than four times the value obtained by Mr. Evershed, and the reason may be partly due to the fact that (as already noticed in Section A) we have hitherto regarded the rate of loss of heat as being directly proportional to the difference of temperature. On turning to Mr. McFarlane's paper we find his result may be expressed as follows:

Loss of heat per second per square centimetre of a bright copper ball 2 centimetres in radius for a difference o temperature θ° C.

$$= \text{Loss for } 1° \text{ C.} \times \theta \left(\frac{0.000168}{0.000170} + \frac{1.98}{.000170} \times 10^{-6}\,\theta - \frac{1.7}{.000170} \times 10^{-8}\,\theta^2 \right).$$

Instead, therefore, of writing, as above, the expression for the rate of loss of heat in watts required to maintain a long wire l_o centimetres in length at a temperature θ° C. above that of the surrounding space, it will probably be more correct to write it as something like:

$$0.0008848\ \pi\ l_o\ \theta \left(\frac{0.000168}{0.000170} + \frac{1.98}{.000170} \times 10^{-6}\,\theta - \frac{1.7}{.000170} \times 10^{-8}\,\theta^2 \right)$$

If now we substitute 360 centimetres for l_o in this expression, it becomes

$$\theta\,(0.9883 + 0.01165\,\theta - 10^{-4}\,\theta^2) \text{ watts.}$$

Of course, we cannot expect this expression to give absolutely correct results for any values of θ, seeing that Mr. McFarlane's experiments did not extend beyond θ equal 60° C. The expression is interesting, however, as showing that, in consequence of the negative term, ε must be taken as having a smaller value when θ is high than when θ is low. For θ equal to 180° C., which was about the excess of temperature of the wire in Mr. Evershed's experiments, the formula as it stands cannot be applied, as it leads to a negative answer; but for θ equal to 164.5° C. it gives, as it happens, almost exactly 36 watts, the power Mr. Evershed found was expended in any one of the three wires he tried.

Mr. Evershed informs us that he estimates the temperature to which the wire is raised by measuring its expansion; we, on the other hand, have found it more convenient, with our form of voltmeter, to estimate the rise of temperature of the wire by measuring its increase of resistance. Employing this latter method, we find that, roughly, 3.5 watts per foot are necessary to maintain a very fine platinum silver wire at a temperature of 200 C. above that of the case. This result is rather higher than that obtained by Mr. Evershed, and corresponds with a value of ε equal to about $\frac{0.0002}{d}$.

In the absence of the results of experiments made for many values of θ it is impossible to say what is the exact function of θ that ought to be employed in the expression for the watts, but we are now making experiments with the view of determining this function; from what we have given, however, there is reason to think that the expression for the watts required to be spent in maintaining a long fine wire at any temperature θ above that of the surrounding space is a function of the length of the wire and the excess temperature only, and is nearly, if not entirely, independent of the diameter of the wire.

(*To be continued.*)

The Induction Top.

The action of induced currents developed with inmetallic bodies moving in a magnetic field is splendidly illustrated by the classic experiments of Faraday and Arago. These currents have since been applied to the damping of measuring apparatus and other scientific instruments. An apparatus constructed by Foucault also shows very elegantly the existence of an induction current manifested by mechanical operation. In order to show these same actions by means of more simple appliances, M. G. C. Manet, of Paris, has devised an apparatus, to which attention is called by E. H. in *La Nature*, consisting of a thin sheet of iron mounted on a spindle and arranged to be rotated in the manner of a top. When at rest the disc of iron is attracted by a horseshoe magnet at every point; but when the disc is rapidly turned and either pole of the magnet is presented, or both together, to the surface, a repulsion is at once produced, and the top immediately assumes an inclined position, which it maintains as long as its velocity is sufficiently great. When the speed falls below a certain value, dependent on the thickness of the disc, the strength of the magnet, the distance, position, etc., the repulsion ceases; the disc is then attracted and comes in contact with the magnet, reassuming the magnetic properties of soft iron.

The explanation of these phenomena is very simple. When the magnet is brought close to the moving disc, the latter, turning at a high speed in the magnetic field produced by the magnet, is the seat of induced currents, whose intensity is the greater the greater the speed of rotation. There is thus exerted a mechanical action between the disc and the magnet. The disc can only be in equilibrium if the magnetic attraction is precisely equal to the repulsion produced by the magnet and the induced currents in the disc.

As that repulsion is predominant as long as the disc has sufficient speed, nothing is more natural, paradoxical as it may seem, than the fact of a *soft iron disc being repelled by a magnet.* If the magnet be presented at the edge of the disc in the plane of the latter, the action of repulsion is not produced, and attraction takes place in the same manner as when the top is at rest. This experiment confirms the preceding explanation, for in this case the induction currents cannot be produced, since the disc moves in a plane parallel to the lines of force produced by the magnet, instead of at right angles thereto, as before.

Raleigh, N. C.—The Raleigh Lighting, Heating and Power Company has been incorporated by G. J. Morse and others, with a capital stock of $25,000.

* A paper read before the Society of Telegraph Engineers and Electricians.

† *Jour. Soc. Tel. Engrs.*, Vol. XIII., 1884, p. 243.

‡ *Proc. Roy. Soc.*, No. 231, p. 468.

§ "A new form of spring for electric and other measuring instruments."—*Proc. Roy. Soc.*, No. 230, 1884, p. 306.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
168-177 POTTER BUILDING, NEW YORK, Jan. 30, 1888.

Electric Lighting in Brooklyn.

The bids of the electric light and gas companies for the privilege of lighting Brooklyn's streets during 1888 are all in the hands of the Aldermanic Committee on Lamps and Gas. The bids are as follows: Citizens' Electric Illuminating Company, $182.50 per lamp per year; Municipal Electric Light Company, $182.50 per lamp per year; Citizens', Metropolitan, People's and Nassau gas companies, each $22 per light per year; Williamsburgh Gas Company, $21.75; Brooklyn Gas Company, $19.80. These same prices were charged last year, and under them it cost $388,925 to supply the city with light. The appropriation for that purpose was only $360,000, but the appropriation for the ensuing year is $480,000, and there is a balance over and above that of $20,000, so that the electric light companies, one of which is in the Eastern District and the other in the Western, will find their receipts from the city largely increased over what they were last year. The increase in the appropriation will be devoted to extending the electric light wires.

The two electric light companies of Brooklyn, which are under the same management, have offered to supply the city at 50 cents per night for each light, the price they received last year, but Alderman Henry A. Smith has sent to Albany an act fixing the price for electric light in Brooklyn at 30 cents per night for each light of 1,200 candle power, and 40 cents per night for each light of 2,000 candle power.

Trinidad Wire.

The Callender Insulating and Waterproofing Company is full of business and rushed with new orders. Its Trinidad line wire is in specially brisk demand. The Tyler, Tex., Electric Light Company, which is putting in a Westinghouse alternating plant, has adopted it for all its overhead wires, and this is but one example out of many.

Baxter Motor Installations.

Mr. T. McCoubray, Jr., who represents the Baxter motor here, reports an excellent outlook. He is receiving some first-class testimonials as to the work of the motor. From Parfitt Bros., the architects in the Garfield Building, Brooklyn, he has the following: "We are very much pleased with the motor we put in the Universal Building, Brooklyn, especially so as it gives us a steady, sure power. * * * The regulation seems to be perfect, and we learn that the Citizens' Electric Company will accept no other to work off their current here." Liebman Bros. & Owens write that the motor is running their elevators "very satisfactorily." E. Wightman, the superintendent of the Danbury, Conn., Electric Light Company, writes: "The motor works to a charm, and does not disturb the circuit in the least, with or without load, on or off, at pleasure. It has attracted considerable attention. Some of our directors have seen it and are pleased with the result." Mr. McCoubray has encouraging reports also in New York.

Indurated Fibre.

The uses and developments of the manufacture of indurated fibre ware are broadening almost daily. We learn that for some time experiments and negotiations for the use of this material in the manufacture of refrigerators have been progressing, and last week culminated in the placing of a large order by Messrs. Monroe Bros. of Cleveland, O., manufacturers of the Monroe stoneware lined refrigerator. It is proposed to substitute indurated fibre for the entire inside lining of the refrigerator, in lieu of zinc, stoneware or wood. The well known properties of indurated fibre,—tasteless, odorless, non-absorptive of either moisture or odor, and cleanliness, together with the fact that it is one of the best non-conductors of heat,—adapt it without question to this service. Its use will also reduce the weight of the refrigerators. It is even expected to utilize this material for the lining of the doors, and as the indurated fibre will neither shrink nor swell, the doors of both food compartment and ice chest can be nicely fitted, and will never get out of order. I have already noted the introduction of this fibre for electrical purposes, and the above suggests even new uses in that line.

Cowles' Patented Line Wire.

It is now close upon five years since the Cowles fire-proof and weather-proof line wire of the Ansonia Brass and Copper Company was patented. In those days there seemed but little outlook for the general introduction of such wire, but those of us who have watched the growth of the business know that the change of opinion on the subject of insulation for line wire has become more and more marked, until now the old wires which once answered the purpose no longer suffice. The Cowles wire is approved by the New York Board of Fire Underwriters, and it has what perhaps is of even more importance, the approval of a large community of buyers. This wire is specially fitted to withstand the severe weather and damp sea air of the Atlantic cities. In fact the various insulated wires of the Ansonia Company are peculiarly adapted to the exacting requirements of the most perfect electrical construction, and as I have above pointed out, may be said rather to have created the demand for better work and wire than to have followed it.

Steel for Magnets.

Among the metal specialties that now constitute an important part of the supply business are those of the Chrome Steel Works, Brooklyn, N. Y. They have chrome steel which they recommend for magnet steel, bar steel for dynamos and generators, and steel indicators and armatures. Excellence of material in this department cannot, as recent researches show, be in anywise neglected, whether for permanent or for electro-magnets.

Lidgerwood Boilers.

The Lidgerwood Manufacturing Company, of 96 Liberty street, J. H. Houghton agent, have, it is said, considerably over 4,000 of their boilers and hoisting engines in use. The company have made a leading feature of electrical plants, and are ready to execute contracts of the most extensive nature.

Asbestos.

The Chalmers-Spence Company, 419 to 425 Eighth street, New York, are calling attention to their asbestos for boiler and pipe coverings for electric light plants. Wherever there are hot surfaces exposed around a station, the application of asbestos is a precaution that common sense suggests and that official inspection often insists on.

Artistic Electric Light Fixtures.

While the improvement in the more prosaic details of electric light installations has been very pronounced and rapid, it has certainly not been greater than is to be observed in the various fixtures that carry the lamps, especially those for incandescent service. In fact, electric lighting may be said to have developed a new department of æsthetics, in which the brightest and lightest fancy has luxuriated, so that by comparison with its products, the old gas fixtures of even but a few years ago are utterly crude and barbaric. Among the pioneers in this line of work are Bergmann & Co., 292 Avenue B, this city, whose designs are now to be found in all parts of the world. So great has been the increase in their business that the company has been compelled to establish an annex factory on First avenue. Not only is attention paid to exterior beauty, but from time to time improvements are made tending to greater safety and cheapness. Some of their latest products, now to be seen at the show rooms at 65 Fifth avenue, are worthy of high praise for their beauty, finish and ingenuity.

Edison Low Volt Lamps.

The Edison United Manufacturing Company has taken to itself the control of the miniature and low-volt lamp business of the Edison system, and has placed Mr. W. H. Meadowcroft in charge of that department at 65 Fifth avenue, where he will furnish quotations for all sizes of lamps from a quarter c. p. up to 32 c. p. of low voltage, and for any special size required. He will also be glad to hear from those who may require lamps for laboratory, experimental and general use.

Mr. C. A. Benton,

the New York Edison agent, has just completed a marine plant—that on board the new ferry-boat "Ohio," of the New York & Brooklyn Ferry Company's line. The plant consists of a No. 2 dynamo for 50 lights, and the boat is wired for 70 lights. All the latest improved appliances are included. I may add that the plant contracted for by Mr. Benton for the Broadway and Seventh avenue car stables will be operated by two Wetherell Corliss engines. Grimshaw wire will be used.

Belt for a Street Railway Plant.

I hear that the belt on the Jamaica Electric Railway plant, now beginning to run, gave out the other day at 9 A. M. The company sent at once to Chas. Schieren & Co. for a link belt, put it on and had the plant in operation again before noon the same day.

The American System in Mills and Factories.

I have the following from Mr. E. H. Goff: "The mills and factories in various sections of New England are going into electric lighting to a great extent, and the American system, judging by the number of new installations and the satisfaction expressed by the users of the light, is in high favor with them. The Arlington mills, of Lawrence, Mass., are now using about 450 lights, and it is said the management is contemplating a large addition to the present plant. The Washington mills, another large corporation of Lawrence, is also using about 450 lights of the American system. The Amoskeag mills corporation, of Manchester, N. H., which was the pioneer New England manufacturing concern to use electric lights, has been employing between 600 and 700 of various systems, it seeming to have been the idea of the management to try the different systems with the view of ascertaining which would give the best satisfaction. An increase of 50 lights was made a few weeks ago, and the American system was adopted. The new installation is said to be giving good satisfaction. The Fitchburg Railroad has recently adopted electric lights for workshops. An American plant has been installed and is working satisfactorily. One of the most successful and best managed electric light companies in New England is the Somerville Electric Light Company, of Somerville, Mass. This company operates about 150 lights of the American system, and is contemplating a large increase."

Objecting to Electric Light Poles.

Edward H. Ridley and Arthur J. Ridley, the owners of Ridley's dry goods store, Grand and Orchard streets, have got an injunction from Judge Andrews restraining the East River Electric Illuminating Company from obstructing the sidewalk in front of the ir premises by erecting on it a "pole or column."

W. T. H.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
48 Congress Street, Boston, Jan. 30, 1888.

New Factory of the Armington & Sims Engine Company.

The Armington & Sims Engine Company, of Providence, R. I., had for some time past contemplated the important step which has recently been consummated, *i. e.*, the removal of its immense manufacturing plant to a larger building to enable it to keep pace with its enormous and rapidly increasing business.

In July, 1887, this company purchased the Monohassett Mill estate on Eagle street, formerly owned by Paine & Sackett, and immediately commenced to put the property in condition for its rapidly increasing business. The company had in 1882 an average production of 18 h. p. per day, while in the year 1887 it had reached 90 h. p. per day.

The Monohassett Mill property is situated on 2¼ acres of land in the southern suburbs of the city of Providence. A number of handsome brick structures constitute the extensive factory property; the total floor space being about 65,000 feet. The main building is a large four-story brick structure 52 feet wide and 104 feet long, and will be almost exclusively used as a machine shop. The two-story brick building immediately adjoining is 60 feet wide and 100 feet in length and will be occupied as the erecting shop for small engines, say from 5 to 50 h. p. The two-story brick structure just to the rear of the last named building is the erecting shop for the largest engines, 50 h. p. and upward. This building is 50 feet wide and 75 feet long. Between the two erecting shops is a one-story brick edifice, which is equipped with the most modern of improved machinery for testing the engines before shipment. This shop is so arranged that four engines of 250 h. p. each can be tested at one time. The overhead cranes and cars are marvels of skill and finish. They work rapidly and with remarkable ease, and are capable of lifting 12 tons. The elevated roadbed on which run the cranes and cars passes from the large engine erecting shop, through the testing room, then into the small engine shop, and thence to various points in the extensive court-yard. In addition to the above mode of transportation for engines and heavy machinery the lower floors of the main building and erecting shops are respectively supplied with a narrow gauge surface road, equipped with cars of several sizes. There are three other small brick buildings adjoining those already mentioned, which are used for special purposes, *i. e.*, pattern shop, drafting and photograph departments, brass foundry and blacksmith shop and the office building. The latter is the attractive one-story edifice which the visitor sees upon entering the gates and which stands apart from the other buildings. It is divided up into the offices and counting room of the company. The private offices respectively of Mr. Pardon Armington, the treasurer, and Mr. Gardiner C. Sims, the general manager, are just off the extensive and well appointed counting room. The offices referred to are magnificently furnished and the walls mounted with walnut paneling and wainscoting, and adorned with valuable paintings and engravings. Everything the eyes rest upon evinces good taste and excellent judgment.

The steam plant of the company's new factory is located on the first floor of the main building. It has undergone such a renovation that the former occupants would not recognize it. The re-equipment of the entire engine and boiler room was made under the exclusive supervision of Mr. K. M. Jarvis, the president of the Jarvis Engineering Company. Four new 60 h. p. boilers, surrounded with heavy brick walls, fitted with the Jarvis setting and Sheffield grate bars to burn cheap fuel, form an important feature of this department. Nowhere can be found a more cheerful looking and cleanly engine and boiler room.

The floor space of the various buildings can be enlarged at any time. A "monitor" roof will soon be added to the main building, and another story can be added to any of the smaller brick structures when necessary. This will enable the Armington & Sims Engine Company to develop its business as now contemplated. To explain: Besides the manufacture of electric light engines the company intend now to resume the making of large engines for manufacturing purposes. Orders for the latter style of engine are already in hand and constantly increasing.

In the old establishment the company was unable to fill orders promptly. For two years past—months of July and August excepted—the old works were in "full blast" three evenings per week. With the company's increased manufacturing facilities it is believed that night work will be dispensed with; at least for a few months. In addition to the special machinery built by the company itself for its new factory, the following prominent concerns have furnished their latest make of improved machinery and labor saving appliances, viz.: Brown & Sharpe, and Nicholson & Waterman, of Providence, R. I.; Pond Machine Tool Company, P. Blaisdell & Company and Prentice Brothers, of Worcester, Mass.; Chas. C. Newton and the H. B. Smith Machine Company of Philadelphia; Manning, Maxwell & Moore and the Lidgerwood Manufacturing Company, of New York. The last named concern put in the new factory $20,000 worth of machinery, consisting of overhead traveling cranes, the designs for which were furnished by the Lidgerwood Company's superintendent, Mr. John Beekman. The steel rails, cars and turn-tables were supplied by William Wharton, Jr., & Co., of Philadelphia, and the chain-hoists by Harrington, Son & Co., also of that city. The main lines of shafting are fitted with Hill's friction clutch, so that the machinery can be shut down at will. On every floor of the main building, the lavatory and other conveniences for the workmen are of the highest order. Protection against fire has been carefully looked after both as regards the lives of the employés and the saving of the property. Large iron fire escapes are convenient of reach, and enormous hydrants supplied with water from an immense reservoir on the roof can be operated from any floor at a moment's notice.

Messrs. Pardon Armington and Gardiner C. Sims, originators of the "Lawrence Engine," transferred their manufacturing interests from Lawrence, Mass., to Providence, R. I., in the year 1882, and established their works at 546 High street, in the latter city, under the now well-known name of the Armington & Sims Engine Company. They continued the building of engines for various purposes, but more especially the kind most desirable for electric lighting (high speed), as their machinery was particularly adapted for engines of this style. Since the establishing of the works of Messrs. Armington & Sims in Providence, the distinctive qualities of their work have given them a world-wide reputation, and their engines can now be found in almost every country. These engines are to-day being built under letters patent in England, France, Germany, Sweden and Canada. At an exposition recently held at Havre, France, the French builders of the Armington & Sims engine were awarded a gold medal for the superiority of their production over other competitors. At the annual meeting of the French engineers held last year in Paris a very favorable report was made on the merits of the Armington & Sims engine for electric lighting purposes. Government officials of Germany reported recently that a small engine (of the make herein named) tested by them showed a consumption of only 30 pounds of steam per horse-power per hour.

It is worthy of note that while this company builds a standard single crank outboard bearing engine for all purposes where power is required, and many of these engines are in use in cotton and woolen mills, as well as electric light stations, the proportion of horse-power is as twenty to one in favor of the double crank engine for electric lighting.

Special machinery, combined with a rapidly growing business has enabled the Armington & Sims Engine Company to reduce the cost of its production as well as the selling price. In conclusion, a few words further regarding the popular electric light engine made by the company named herein will, probably, be appropriate.

No engine has met with greater success or achieved more general popularity in the electric light field. Of over 2,000 engines built or in process of construction, up to the present writing, by far the larger portion of them are driving dynamos. The advan

tages claimed for this engine are as follows: Extreme simplicity; the entire absence of parts requiring frequent adjustment; great regularity of speed; small cost, especially for the greater powers; small space required for engine and fly wheels; a compact form, and consequent rigidity in stationary and moving parts, unattainable in engines of long stroke; the employment of short and nearly parallel belts in place of long converging ones; the avoidance of intermediate gearing, to produce the speed required; great saving in room, building and foundations. The automatic cut-off regulator is original is every respect; it is perfect in its operations. All its parts can be readily reached, and are always in sight. It is attached directly to the valve-rod, and varies the point of cut-off as the resistance requires, from the commencement to seven-tenths of the stroke without changing the lead—a feature peculiar to this regulator. It acts instantaneously, and whatever the change in load or pressure of steam, the speed remains constant. The total variation in speed from an extreme light load to the capacity of the engine, will not exceed two per cent.

Adams, Mass., Electric Light Station.

The town of Adams, Mass., will soon have an electric light and power station.

Lynn Electric Light and Gas Companies.

The Electric Light and Gas Light companies, of Lynn, Mass., are reported to have consolidated.

Chelsea Gas Light Company to Furnish Electric Lights.

The Chelsea, Mass., Gas Light Company has ordered an electric light equipment, which is to be immediately installed on its premises. In a few weeks the company will be prepared to furnish both arc and incandescent lights. The electric light plant will be equipped with Thomson-Houston dynamos, Armington & Sims engines and boilers set with the Jarvis furnace, the latter arranged for burning coke.

Electric Lights for Stoughton, Mass.

At a town meeting in Stoughton last evening, Oscar M. Marden, moderator, it was voted to introduce electric lights into the streets of the village, provided it could be done for $2,000 per year. A committee, consisting of Charles Tenney, Henry Fitzpatrick, Nathan S. Atwood, George F. Walker and John M. Dennis were chosen to make a contract with some company for the period of five years.

Regular Monthly Meeting of the Boston Electric Club.

The next regular monthly meeting of the Boston Electric Club will be held at the club rooms, No. 66 Boylston street, on Monday evening, Feb. 6. Important amendments to the constitution and by-laws will receive final action at this meeting, and other matters of interest will be presented in which every member should have a voice.

Electric Motors.

Messrs. Sawyer & Blake, the New England agents of the Sprague Electric Railway and Motor Company, report business in their line as very satisfactory. Among their recent installations in Boston is a 20 h. p. motor, said to be the largest machine of the kind now running in New England.

Jarvis Engineering Company.

Mr. J. N. Pratt, the manager of the Jarvis Engineering Company's New York office, will assume the general management of the company and have his office at the Boston headquarters during the absence of Mr. A. F. Upton.

Dividend by N. E. Telephone & Telegraph Company.

At a meeting of the directors of the New England Telephone & Telegraph Company a dividend of one dollar and twenty-five cents per share was declared, payable Wednesday, Feb. 15, 1888, to stockholders of record at the close of business Tuesday, Jan. 31, 1888. The transfer books will be closed from Feb. 1, 1888, to Feb. 14, 1888, both days included.

Telephone Connection with New York.

Under the above heading the Boston *Daily Globe* of recent date has the following to say: The question of long-distance telephoning is gradually being solved, and it is now possible to talk very easily through the telephone between Boston and New York. The *Globe* has recently added such an institution to its facilities, as have also the Potter & Lovell Banking Company (E. H. Corey, New York manager) and a few other enterprising firms. Usually the conversation can be carried on as easily through this telephone from Boston to New York as is possible between any two points in the city of Boston.

Arc Lights in Brockton, Mass.

Advices from Brockton, under date of Jan. 24, state that there is a very strong probability that a company may be formed in this city within a very short time for the purpose of putting in a new arc light.

Control of Electric Lighting in Cambridge, Mass.

The Boston *Journal*, Jan. 28, contained the following: There is a lively contest going on in the Cambridge Electric Light Company. Not long ago the superintendent and several directors favorable to the American light system attempted to get possession of enough stock to secure a controlling interest. They succeeded in buying up 297 out of the 600 shares before the remaining directors learned what was going on. The latter immediately set to work to protect their own interests by an effort in the same direction. Within twenty-four hours from the time they started out they had secured pledges for the remaining 303 shares of the stock. This stock is now being transferred to an agent, and when it is all in his possession it will be sold in a block to the Thomson-Houston Company, which will assume the management of the Cambridge plant.

Poles at Somerville, Mass.

There is no little agitation at Somerville over some new big telephone poles, and a meeting was held recently of the aldermen to hear the pros and cons. The poles are 55 feet high. Petitions against them were presented from a number of citizens. The New England Telephone Company, owning the poles, was represented by the Hon. G. A. Bruce, who was hardly of opinion that the poles damaged property 20 to 25 per cent., as claimed.

The Electric Light at Hyde Park, Mass.

Hyde Park, which is a suburb of Boston, has a population of about 9,000. It is a manufacturing town as well as a place of residence for people doing business in the city. For the past two years the question of lighting the streets by electricity has been agitated, and six months ago the town decided to adopt that form of illumination. After the appointment of committees and a most thorough examination of the subject, the American system was finally adopted by the selectmen, and a contract made with the American Electric Manufacturing Company of New York to light the streets with 75 arc lights. The company put in a 100-light plant, and it is said that the installation is one of the finest in Massachusetts. The lights were started on the 14th of January, and, according to the local paper, the *Norfolk County Gazette*, the people were jubilant over the occasion. It is said that the town will need 100 lights, and that the mills and stores in the town will also use the light to a considerable extent, so that it is safe to say that it will not be long before the present number of lights in the town will be doubled.

Pawtucket, R. I.

The gas and electric light combination is making satisfactory progress in New England. One of the most recent converts to this system of mixed lighting is the Pawtucket Gas Co., of Pawtucket, R. I., the general manager of which, Mr. Stiness, is laying out to do a large amount of electric lighting in connection with his gas industry. He is building one of the finest stations in New England, and has adopted the American system, which is now being installed.

Personals.

Mr. Cyrus O. Baker, Jr., of the firm of Baker & Company, platinum refiners, Newark, N. J., favored this office with a visit last week.

Mr. A. F. Upton, Treasurer of the Jarvis Engineering Company, starts to-morrow for the South. It is probable that Mr. Upton will be absent from Boston about six months.

Mr. P. H. Alexander, who has been enjoying a vacation in the South during the past fortnight, sends the following dispatch to the Boston Electric Club, dated St. Augustine, Fla., Jan. 22: "Myself and W. J. Hammer having met in this sunny clime, send greetings to their shivering friends by telegraph and oranges by express."

The Boston Society of Arts, at the meeting of the Society on Thursday, Feb. 2, at 8 P.M., M. A. J. Purinton will read a paper on "Steam Engine Experiments in the Mechanical Engineering Laboratory of the Massachusetts Institute of Technology," and Professor C. H. Peabody, of the Institute, will give a general review of steam engine tests.

Telephone Tattle.

The new telephone year opens fairly, there being a net gain of 340 instruments in the first month for the Bell Company, as shown below:

Month Jan. 20.	1887-88.	1886-87.	Increase.
Gross output	4,030	3,974	56
Returned	1,672	1,956	*284
Net output	2,358	2,018	340

*Decrease.

Mexican telephone has risen to 1½ on its improved prospects, based on the overthrow of the opposition company, which was underselling it in the matter of instruments. W. I. B.

PHILADELPHIA NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
39 South Tenth Street, Philadelphia, Pa., Jan. 30, 1888.

An Edison Plant for Baltimore.

A dispatch from Baltimore says that the Edison Electric Light Company, of that city, has been incorporated. It proposes to light streets, residences, and other buildings, and provide motor power for machinery. A special act of the Legislature will be necessary before the company can go to work, as there is a law prohibiting the erection of poles or placing the wires underground. Prominent citizens have undertaken the work.

A Lecture on Incandescent Lamps.

Professor William D. Marks, of the University of Pennsylvania, lectured on Friday evening, Jan. 20, at the Franklin Institute, on the duration of incandescent electric lamps.

"An incandescent lamp consists of nothing but a little bit of carbon and glass, they think, but they do not think of the vacuum inside. That is the expensive portion of the lamp. There must be a perfect vacuum; but the people cannot see the vacuum and they do not want to pay for it. I do not know of what the carbon loop inside is made; that is the secret of each maker. The carbon itself is not charcoal, as is ordinarily said; it is nearer graphite. If we begin with an ordinary candle there is a mass of tallow with a wick. The tallow works up the wick and is vaporized. The interior of that flame is hollow and filled with hydrogen gas. With an oil lamp it is the same thing, with oil instead of tallow. Gas vaporizes itself and undergoes the same process. An incandescent light consists of a loop of carbon in a vacuum, and as the current is turned on there is first a limpid glow and then a clear, steady light with no flickering, being perfectly steady under good management. Gas flickers in a slight draft. The incandescent light seems to meet the almost unconscious demand of the public. Arc lights are cheaper, and in the street they do good service."

The Professor then illustrated the method of measuring light with the photometer, during which explanation he continued: "A lamp to give a good investment must burn a thousand hours. If a lamp of 16 candle-power is increased in power to 32, the illuminating power is doubled, but the life of the lamp is shortened one-sixteenth."

Mr. C. Knapp on Electrical Measurements.

At a meeting of the Electrical Society, held at its hall, 1714 Chestnut street, last Monday evening, President Law, of the Brush Electric Light Company, introduced Mr. Charles Knapp, electrician of the Baltimore & Ohio Telegraph Company, who delivered an interesting lecture on "Electrical Measurement." The stage was filled with apparatus used in explaining the mode of measuring conductivity, resistance and insulation. A large scale was suspended on the wall, the spot of light was thrown thereon, and the deflection of the galvanometer shown. A number of interesting experiments were made. The recent damage to telephones at various places in this city is attracting the attention of the society, and for this reason the electric light main circuit of the Brush Company was introduced into the room, and tests were made of devices for protecting property where telegraph or telephones are used.

Telegraphers' Aid Society.

A permanent organization of the Telegraphers' Aid Society, of Philadelphia, was effected at the Western Union main office, Broad street and South Penn square, last Monday evening. The attendance was quite large, about 160 operators having signed their names as favorable to the formation of the new organization. Constitution and by-laws were adopted, which included among their provisions the payment of fifty cents dues per month, and the payment of $50 death benefits, and $7 per week in case of sickness. Officers were elected as follows: President, Joseph E. Janney; Vice-President, Joseph Berrett; Recording Secretary, C. B. Wood; Financial Secretary, Robert C. Mecredy; Treasurer, H. W. Hetzel; Executive Committee, Joseph T. Wilde, Ernest W. Emery, Thomas Dillon, A. H. Lang, E. Louis Maize, W. E. Vanarsdall, Miss Emilie W. Uhlinger, Miss Helen Merrick, Miss Ella Wehmann, and the president, secretary and treasurer, who are *ex-officio* members. The members are taking an active interest in the work of organization, and it is expected that by the time the next meeting occurs fully 200 members will have been enrolled.

A Fire in the Postal Telegraph Office.

About ten o'clock last Monday night fire was discovered near the switch-board of the Postal Telegraph and Cable Company, at the main office, on the top floor of the building, at the northeast corner of Third and Chestnut streets, and before the flames were subdued the room was gutted. There were accommodations for about forty operators, and the loss to the company, including instruments, switch-board, etc., is estimated by Superintendent Adams at $5,000, on which there was no insurance. It is said that the fire was caused by an electric light wire "crossing" one of the company's circuits, but the "cross" has not yet been located. With the assistance of a large force of linemen and the securing of temporary quarters in the adjoining building, the company were enabled to resume business on Tuesday with but little delay. The work of refitting the destroyed operating room was begun immediately, and within a week everything will be running in its usual good shape.

License Fees for Telegraph Companies.

The Supreme Court has affirmed the judgment of Common Pleas Court No. 2, in the suit of the city against the Western Union and Mutual Union telegraph companies to recover from those companies the annual license fee of $1 for each one of their poles erected upon the public streets, and $2.50 for every mile of suspended wire. These license fees were imposed by an ordinance of Jan. 6, 1881, but have never been collected. In affirming the judgment, the court simply holds that the city, in the exercise of its police powers, has an undoubted right to impose a license fee on poles and wires, and that there is nothing unreasonable about the amount fixed for the fee. E.

WESTERN NOTES.

Items of interest belonging to this department should be forwarded to Mr. E. L. Powers, manager of the Western Office, 44 Lakeside Building, Chicago. It is the desire and intention of THE ELECTRICAL WORLD *to devote its space to electrical news and events in all parts of the country equally, and any contributions to or correspondence for the Western Notes, tending to render them more complete and valuable, will be greatly appreciated.*

BRANCH OFFICE OF THE ELECTRICAL WORLD,
44 Lakeside Building, Chicago, Jan. 28, 1888.

New Incorporations.

At Springfield, Ill., the Secretary of State issued licenses of incorporation last week to the following companies:

Citizens' Electric Light and Steam Heating Company, at Peoria; capital, $25,000; incorporators, F. M. Ames, G. A. Scheeffer, K. C Pardee, W. H. Day and others.

The Anna Electric Light Company, of Anna, Ill.; capital, $25,000; incorporators, Wesley Henderson, Charles V. Nordling and Christian Nordling.

Electric Supply Company, of Springfield; for the purpose of manufacturing fire and burglar alarms and other electrical apparatus; capital, $50,000; incorporators, Andrew Schuman, Robert B. Hoover and Frank W. Wellman.

Telephones for the Parks.

The Chicago Telephone Company was instructed last week by the West Park Board to stretch wires connecting Garfield, Humboldt and Douglas parks, at a cost of $600 for the three.

Western Electric Company.

The Western Electric Company are very busy in all their departments. Among other recent sales were: 140 arc lights to the St. Louis Exposition Company; a 35 light plant to Pasadena, Cal., and a 45 light plant to Kahn, Wampold & Co., Chicago.

Copper Wire.

Owing to the advance in copper there is a noticeable falling off in the sales of copper wire. Buyers seem to prefer to wait for a drop in the market before investing.

Adams' Elevated Electric Road.

The agitation with reference to some sort of rapid transit for the west side continues. Many schemes have been proposed. Among others is the Adams' elevated system, to be propelled by electricity, which City Electrician Barrett is reported to have indorsed as best adapted for the application of electricity for an elevated road of any he has seen.

Order of Railway Telegraphers.

The first reception of the Order of Railway Telegraphers of North America, Chicago Division 42, was held at Martine's Hall, on the West Side, this week. There was a large attendance, and the occasion was an altogether pleasant affair.

Warder Grand Opera House, Kansas City.

Mr. Theo. P. Bailey, general agent of the Thomson-Houston Company, has just returned from a trip to Kansas City, and has a great deal to say to his friends regarding the Warder Grand Opera House, which was recently installed in that city, and which he says is a "model." The entire lighting of the house is controlled by a single switch-board, with a pilot lamp for each and every circuit in the building, so that the electrician can control

the lights at the direction of the stage manager. The pilot lamps thus constitute an index at all times of the condition of the lights in the theatre proper. Mr. Bailey reports business a little dull just now throughout the West, as compared with the same season last year, but the outlook is very promising.

A Plant for a Chicago Hotel.

Mr. E. W. Horne, the Western manager of the Excelsior Electric Company, was on the 26th inst. awarded the contract for lighting the fire-proof European Hotel on Clark street, near the Grand Pacific Hotel, which is now under construction and is, I believe, to be the largest of its kind in the city. The contract is for a thousand lights, and also comprises the complete outfit, consisting of engine, boilers, etc. The work of wiring will be commenced at once, rubber wire being used. This is the first large contract made by this company for putting in their incandescent system, and Mr. Horne may with pardonable pride feel elated at his success in carrying off the prize.

A New Gas Rate Ordinance.

An order was adopted by the City Council last week, directing the Corporation Counsel to draft a gas ordinance on the basis of $1 per thousand to the city and $1.20 to private consumers in all parts of the city, the same to be submitted to the gas companies for their adoption.

The Cushman Telephone.

The Cushman Telephone Service Company moved into their new offices last week in the United Express building. This company recently went before the Committee on Fire and Water and asked for the passage of an ordinance allowing it to establish a telephone exchange and to lay wires in every part of the city. It will agree in the ordinance to charge not to exceed $80 per telephone to subscribers, and in private residences not to exceed $75 per annum. The committee referred the matter to the Law Department, with instructions to draft an appropriate ordinance, which will then be given careful consideration.

Rawhide Belting.

Last week I called upon the Chicago Rawhide Manufacturing Company, who are the only manufacturers of rawhide belting in the United States, and, besides, have the distinction of having placed the belt on the first dynamo operated in this city, some nine years ago. This belt, Mr. Preble, the secretary and treasurer of the company, informs me, is still in service. A belt is now being put on the market by the company made with special reference to the requirements of running dynamo machinery. The claim made for it by the manufacturers is that it is pliable and has no stretch beyond the proper elasticity; besides that, they claim that on account of its having extreme adhesive qualities it can be run much slacker, which is very desirable, as it causes less friction and strain on the bearings of the dynamo.

Munson & Co.

Munson & Co., manufacturers of the well-known Eagle and dynamo-electric light belting, are busy at their factory preparing for the heavy spring trade, the outlook for which they report as most favorable.

Lava Insulators.

The D. M. Steward Manufacturing Company, of Cincinnati, has now been reorganized under the laws of the State of Tennessee, with a largely increased capital. It has erected permanent factory buildings of large capacity at Chattanooga, and has removed thither its office and works. A number of machines have been added, which will more than quadruple the product, and the company is now nearer its base of supplies, thus avoiding delays on account of shortage of the material from which its well known lava electric insulators, etc., are made. Mr. D. M. Steward is the president and treasurer of the company; J. P. Richardson, vice-president, and M. L. Chapman, secretary.

Standard Underground Cable Company.

The annual meeting of the Standard Underground Cable Company was held at Pittsburgh a few days ago, when the following directors were elected: Geo. Westinghouse, Jr., R. Pitcairn, C. H. Jackson, R. S. Waring, O. T. Waring, J. H. Dalzell and W. W. Watson.

The Herzog Teleseme.

The Herzog Teleseme Company has been organized in this city, with a capital stock of $1,000,000, to buy and sell all kinds of electrical appliances; incorporators, Edwin J. Ovington, Jr., Frank H. Collier, and Charles H Walker.

The Link Belt Machinery Company.

The Link Belt Machinery Company report that they have been unusually busy in a general way, and specially so in executing orders for friction clutches, particularly adapted for driving electric light dynamos. The Pullman Palace Car Company bought nine at one order recently. The company say that the business outlook is very promising.

The Van Depoele System.

A syndicate, represented by Martin Kingman, Frank J. Miller and James H. Rice, of Peoria, have examined nearly all the Van Depoele electric railways in the United States, and have adopted the Van Depoele system for their new road at Peoria. They have also contracted for 12 cars equipped with Van Depoele motors, and a large station equipment of generators, etc., for electrical power. They speak in high praise of the Van Depoele electric roads. The motor car, with 60 h. p. motor, for Ansonia, Conn., has been shipped from the Pullman Car Works, where it was constructed. This motor is for hauling freight, and the Ansonia road will be started as soon as the engine-house is completed. Seven of the electric cars for Dayton, O., have just been completed at Pullman, and the Van Depoele Company are placing the motors upon them. The electric railway at Wheeling, W. Va., is approaching completion. Seven of the cars have been shipped from the St. Louis Car Company's works at St. Louis, and the motors and generators are nearly completed at the Van Depoele shops. A letter to Manager Stiles, under date of Jan. 25, from the St. Catherine's, Merriton & Thorold Electric Railway Company, says: "The railway is working very well, and we can find no fault with it." Judge Harriman, of the Appleton, Wis., Electric Street Railway Company, writes, on Jan. 27: "We are running nicely, and would convince any one that we have the model road, so far as running it is concerned, snow or no snow." The superintendent of the Lima electric road says: "Snow can't stop us. We can clear track easier than horses." Mr. Stiles informs me that nearly all of their ten roads are ordering extra equipment for spring. The company are also doing considerable electric light work at the present time.

Lighting Railroad Cars.

It is reported that the Atchison, Topeka & Santa Fe Railroad Company is fitting up its cars with storage batteries for lighting purposes.

The Central Electric Company.

The Central Electric Company, McKinlock Bros., have secured the services of Mr. W. W. Low, who will represent them the coming season as traveling salesman throughout the West. Mr. Low was formerly with the Detroit Electric Works in the same capacity.

The Union Depot Plant.

The Union Depot, from Madison street to Van Buren street, is now brilliantly lighted by electricity. This plant, which was installed by the Thomson-Houston Company, is a model in many respects. It consists of 60 arc lamps and 900 incandescent. It commenced running on the 26th.

Another Fire at C. E. Jones & Bro's.

On Jan. 21st a fire occurred in the electrical manufactory of C. E. Jones & Bro., Cincinnati, doing considerable damage. The loss was about $10,000, which, however, was fully covered by insurance. Messrs. Jones & Bro. write that their foundry, plating room and finishing rooms will be interrupted for a week or ten days, but that in other departments they have already resumed work. It may be remembered that this firm was burned out about two years and a half ago. The loss on that occasion was very much heavier than in the present instance.

Shultz Belting Company.

The Shultz Belting Company, of St. Louis, has opened branch offices at 128 Pearl street, Boston, and 140 North Third street, Philadelphia.

San Francisco Items.

Samuel H. Taylor, the Pacific Coast representative of the Thomson-Houston Co., accompanied by John A. Britton, secretary of the Oakland Gas Light and Heat Co., will go East from San Francisco early in February. They will attend the convention at Pittsburgh, and also spend some time in the investigation of power and alternating plants as conducted in Eastern cities.

Pasadena has contracted with representatives of the Thomson-Houston Company to light the city. A local company has been incorporated, with a capital of $50,000, and construction begun.

Telephone Quotations.

Col. S. G. Lynch, broker, 146 La Salle street, furnishes quotations upon telephone stock as follows:

Bell of Mo.	$160	@$165	Iowa Union	$25	@ $26
Central Union	44	@ 45	Michigan	75	@ 76
Chicago	360	@ 370	Missouri and Kansas	68	@ 69
Colorado	19	@ 21	Rocky Mountain Bell	40	@ 45
Cumberland	62	@ 65	Wisconsin	108	@ 109
Great Southern	30	@ 32		E. L. P.	

ENGLISH NOTES.

LONDON, Jan. 11, 1888.

Telephone Service.

Steps are at length being taken to place London in telephonic connection with the north of England. An arrangement has just been concluded by the United Telephone Company and the National Telephone Company for the erection of a trunk wire to Coventry, whence the line will fork in two directions to the left through Birmingham and Crewe to Manchester and Liverpool, and to the right through Nottingham to Sheffield, Leeds and the Yorkshire towns. In contemplation of this extension, the National Telephone Company have for some past been engaged in the erection of heavy copper wires, running about four hundred pounds to the mile, within the limits of their own districts. The chief towns in the north are already, or will shortly be, connected with a double set of trunk wires; one set of wires, running about sixty pounds to the mile, being employed for telephonic communications not extending for more than from thirty to forty miles and the heavier wires being reserved exclusively for the long distance traffic. So far as the National Company is concerned, there is no question but that it will be able to render a thoroughly efficient service. The average time of communication between its subscribers does not in the majority of their exchanges exceed twenty to thirty seconds, and the articulation is as good as can possibly be desired. The multiple switch-board is largely used, and will ultimately replace all other types in the service of this company. In the Metropolitan district, on the other hand, a subscriber thinks himself lucky if he gets through in less than three minutes, and still luckier if the speaking is reasonably intelligible. The company lay the blame for the acknowledged inefficiency of the service upon the fact that the conditions under which they work compel them to employ so large a number of subsidiary switch rooms; of these no less than twenty-three now exist in London. There can be no doubt much might be done to remedy the service if the company were granted Parliamentary powers for obtaining way leaves. This they will once more seek to obtain at the next Parliamentary session.

Treating Sewage by Electricity.

According to a report which has just appeared in the columns of the *Standard*, a Mr. William Webster, F. C. S., has devised an electrical method of dealing with sewage. In order to separate the solid matter he passes a current of electricity through the liquid, when the evolution of gases from the electrode carries the suspended matter to the surface. The Metropolitan Board of Works are at the present time engaged in putting down plant at Barking for the chemical treatment of sewage. This is a most costly undertaking, and involves an enormous outlay. The contract runs to the sum of £406,000. The *Standard*, however, jumps to the conclusion that the plans of Mr. William Webster will be accepted in lieu of those now in progress. As electricians, of course we all hope that this may ultimately come to pass, but it would be ridiculous upon the basis of information at present vouchsafed, to take it for granted. Mr. William Webster's experiments, so far as can be gathered from the *Standard* article, appear to have been conducted in a tumbler of water, and it is rather a long jump from this experiment to a scheme for dealing with the entire sewage of London. The mere fact that in these experiments no less than 20 minutes were required to complete the removal of the solid matter in suspension looks rather unpromising for its practical utility. However, there is no doubt that the subject will bear further investigation, and should the method prove successful it is evident that an enormous new field is opened up for electrical engineering.

Orders for Copper Wire Stopped.

I hear that the British Post-Office has suspended all orders for copper wire for the current year, in consequence of the enormous rise in the price of that metal.

An Improved Pyro-Magnetic Generator.

M. Menges, of The Hague, Holland, is at work upon an improvement in the Edison pyro-magnetic generator, and I understand that he has attained some very important results. In this machine the necessary rotation is obtained in an entirely automatic manner, and, moreover, the core upon which the armature wire is wound is not subject to any variations of temperature. These are evidently two of the most important points to be aimed at in the construction of such machines, and it may at least be said that they go a long way towards securing the practicability of the method.

Electric Recorder for Chess Moves.

I have recently seen at the show rooms of Messrs. Woodhouse & Rawson a very ingenious apparatus devised by Dr. Wurstenberger, of Zurich, for the purpose of obtaining an automatic record of the moves in a game of chess. The game is, of course, played upon a special board and the pieces are provided with pegs which are inserted into holes in the centres of the squares. The squares are numbered and lettered as in the modern method of marking moves and the successive moves are printed upon a tape by a type-writing wheel. The cost of the apparatus is naturally somewhat high and it can scarcely be expected that even the most enthusiastic devotees of the game would often care to pay 80 guineas for such a purpose. I am, however, revealing no secret when I inform you that the ultimate object to be obtained by this apparatus is of a somewhat different character. I cannot say exactly what the final apparatus actually is, but Messrs. Woodhouse & Rawson anticipate that the invention will fulfill an important purpose and that there will really be a considerable demand for the apparatus.

The Grosvenor Gallery Lighting Plant.

The Ferranti transformer installation at the Grosvenor Gallery has, unfortunately, been attended of late by several somewhat serious breakdowns. The Carlton Club, in Pall Mall, has twice over, within a short time, been deprived of illumination. As might have been anticipated these incidents have made a most unfortunate impression, and two or three cases have come under my notice where electric lighting has been countermanded for this reason. The Grosvenor Gallery Company are very chary of giving any information, but it appears almost certain that the fault lay in the transformers, and the moral to be drawn evidently is that the utmost possible care should be taken to secure the insulation of the primary coil.

THE TELEGRAPH.

Cable Rates.—It is reported, although not officially, that the Direct Cable Company has decided to advance the tariff from 12 cents to 25 per word. It is thought that the official announcement and date of advance will be made this week.

Western Union Objecting.—Mr. Beck presented to the United States Senate on Jan. 23 the remonstrance of the Western Union Telegraph Company against the passage of the Postal Telegraph bill. He said that it was a very full presentation of the case, and that the Post-office Committee desired to have the communication printed and referred to it. It was so ordered.

A Long Circuit.—An extraordinary feat in telegraphy was accomplished on the 23d inst., when an interview took place by cable between London and Vancouver, through lines of wire equal to about 8,000 miles. A reply was received within 6 minutes from the Pacific side after the conversation began. The Commercial Cable was used. The conversation was carried on by Mr. Stead, editor of the London *Pall Mall Gazette*, and Mr. Norman, his commissioner. The circuit was extended so as to include San Francisco.

The Snow-Alley Case has come up again, having now been brought before the court at Dedham, Mass. The Snow-Alley case has a somewhat peculiar history, almost as much mixed as the case itself. The suit is brought by Charles Snow, of Barnstable, against Hon. John B. Alley, of Lynn. Some years ago Alley was induced to enter into an electrical enterprise known as the Postal Telegraph Company of New York, in which Snow had made certain inventions, and took a certain amount of bonds. It is claimed by Snow that there was also a private agreement between him and Alley, by which Alley was to advance him personally $20,000 and to buy of him a certain additional amount of bonds. In consideration of this alleged promise, and of the assistance which Alley was to furnish the company, Snow gave Alley, as alleged, 150 $1,000 bonds of this Postal Telegraph Company. Snow claims that Alley did not carry out his promises in regard to this alleged private agreement, and hence the present issue at law, in which Snow sues to recover the value of the bonds, which he claims were obtained by fraud. The value of these bonds the plaintiff puts at $750,000. The defense is a general denial.

THE TELEPHONE.

St. Louis, Mo.—An agitation has begun at St. Louis to reduce telephone rates by cutting them down from $100 to $50. A petition to the local authorities to secure this end is now in circulation.

Time Tests at St. Louis.—Mr. Durant, the efficient manager of the St. Louis telephone exchange, where the Law system is in use, has been making some interesting time tests. He found the average number of connections, as the result of the experiment, per minute, 1.94; per five minutes, 9.72; per hour, 116.7. The average daily work of the exchange is 15,500 connections. The busiest hour is between 9 A. M., and 10 A. M., when 1,900 connections are usually handled.

THE ELECTRIC LIGHT.

Salisbury, N. C., is likely soon to have an electric light plant.

Athens, Tenn.—Mr. J. R. Fisher contemplates installing a small plant.

Brenham, Tex.—A Thomson-Houston plant is to be installed at Brenham.

Macon, Ga.—A permit has been asked for a Thomson-Houston plant at Macon.

Temple, Tex.—A franchise has been granted to New Yorkers for an electric light plant, etc.

Reidsville, N. C.—An electric light plant is proposed for Reidsville, and negotiations are going on.

Oswosso, Miss.—The Oswosso Edison Electric Light and Motor Power Company is to erect a plant.

Buffalo, N. Y.—The station for the fine new Thomson-Houston plant for Buffalo is to cost $40,000.

Clarksburg, W. Va.—The Clarksburg electric light company will erect a plant with a capacity of 800 incandescents.

Lowville, N. Y.—The Lowville Electric Light Company, incorporated by J. J. Moore and others, has a capital stock of $15,000.

Leicester, Mass.—W. & J. Whittemore, manufacturers of card clothing, have put in an electric light plant. L. S. Watson & Co. have done the same.

Trotting at Fleetwood.—Trotting at Fleetwood Park, near this city, by the aid of the Thomson-Houston plant there, is one of the events of the winter.

Houston, Tex.—The Fort Wayne Jenney Company has been awarded a contract for lighting Houston. Mr. T. W. Anderson has a permit to erect an electric light plant.

Harrisburg, Pa.—The Harrisburg Electric Light Company, which is to make several large improvements in its plant, has increased its capital stock from $100,000 to $150,000.

Tallahassee, Fla.—The Tallahassee Gas and Electric Light Company, recently incorporated, has a capital stock of $50,000. Mr. E. S. Crill is President and Mr. W. M. McIntosh Secretary.

Toronto, Kan.—The cost of street lighting at Toronto for 1887 was $84,696, of which $56,780 was paid for gas, the remainder going to the electric light company. Over 150 arc lights are now in use for the streets.

Lewiston, Me.—The city of Lewiston, Me., some months ago decided to do its own street lighting. Ten different companies competed for the contract to furnish electrical apparatus for the purpose. The award was finally granted to the American Company. The plant has just been completed, and the Mayor reports that it is giving perfect satisfaction.

Salina, Kan.—The Salina Gas and Electric Light Company is now putting in an electric light plant, which, when completed, will include one Western Electric arc dynamo of 30 light capacity, 2,000 c. p., one Thomson-Houston dynamo of 35 lights, 2,000 c. p., and one Westinghouse alternating machine of 650 16 c. p, incandescent lamps. A spacious engine and dynamo room has been added to the gas works. The power is supplied by two Ball engines of 100 h. p., and 85 h. p. so arranged that either may be used alone to drive the plant. The shafting, pulleys, etc., were manufactured by the J. B. Ehrsam Machine Co., of Enterprise. Arc lighting is already being done, and the incandescent service is nearly ready.

Figures for Massachusetts.—The third annual report of the State Gas Commissioners shows 64 gas companies in business in this State, with a total valuation of $13,000,000, an increase of $789,000 over last year. The total receipts were $4,655,000, and expenses $3,031,000. The entire capitalization is $11,950,000. There are 56 companies engaged in supplying electric lights.

Kansas City, Mo.—The articles of incorporation of the American Electric Light Company, of Kansas City, have been filed. The capital stock is placed at $25,000, divided into 250 shares, which are taken as follows: Matthew S. Porter, 175 shares; Horace M. Porter, 49 shares; Oscar W. Ditsch, 26. The purpose of the company is to establish and maintain an electric light system in Kansas City.

A Long-Lived Lamp.—The ordinary guarantee of life for Edison's incandescent electric lamps is 600 hours, but one lamp in the *Globe* office has just gone out after a most extraordinary life. It was put in about the end of November, 1884, when the Edison system was installed in the office. It has continued burning ever since on the average five and a quarter hours every day, six days a week, making a total life of 5,292 hours.—*Toronto Globe.*

APPLICATIONS OF POWER.

Chattanooga, Tenn.—The Chattanooga Electric Street Railroad Company has organized with C. A. Lyerly, President; G. N. Henson, Vice-President; E. Scott, Secretary, and C. V. Brown, Treasurer.

Buffalo, N. Y.—The People's Electric Street Railroad Company has asked the city authorities for power to operate a road by electricity on Seneca street, between Main street and Buffalo River. The length of the proposed road is three and seven-tenths miles. The capital stock is divided into five hundred shares of $100 each, which are held by the following named gentlemen: Peter McNeil, ninety shares: Louis Schoellkopf, ninety; J. F. Schoellkopf, thirty; Josiah Jewett, thirty; Francis E. Cornwell, thirty; Harvey J. Hurd, ten; Spencer S. Bullis, of Olean, thirty; J. J. Newman, thirty; Francis Handel, thirty; Louis Kiene, ten; John D. Langner, ten; William H. Lamphier, thirty; Simon Mergenhagen, ten; S. P. Swift, sixty; H. D. Folinsbee, ten. These are the incorporators. The officers are: P. McNeil, president; L. Schoellkopf, secretary and treasurer; J. F. Schoellkopf, J. Jewett, H. J. Hurd, F. Handel and S. P. Swift, dierctors.

PERSONALS.

Prof. George Forbes, F. R. S., has returned to this country upon another visit of business.

Mr. W. H. Snell has received the appointment of editor-in-chief of the London *Electrician*.

Mr. T. D. Lockwood lectured on electricity at Holyoke, Mass., on Jan. 20, in a special scientific course. The lecture was admirably illustrated by experiments, and the reports in the papers show it to have been remarkably well received. One ingenious experiment we note was that in which Mr. Lockwood passed current through a chain composed of three silver and three platinum links. The effect was at once pretty and self explanatory.

Mr. Geo. J. Davidson, formerly manager at Utica, N. Y., for the Western Union and Atlantic & Pacific Telegraph companies, has been appointed manager of the Brooklyn Telephone Exchange. Mr. Davidson is an old telegrapher who has kept abreast of the developments of electricity.

Mr. A. F. Moore, the well-known insulated wire manufacturer, of Philadelphia, has admitted Mr. C. C. King and Mr. A. Bournonville to an interest in the profits of the business, the firm name remaining the same. The calendar issued by the firm is a fine and spirited piece of work that will adorn many offices.

Col. Rowland R. Hazard is elaborating the plans of the Metropolitan Junction Railway Company. The scheme includes a bridge over the Hudson at Washington Heights and the establishment of a grand central depot at Morrisania, both connecting with city travel by means of the proposed underground electric railway, already familiar to New Yorkers as a project.

MISCELLANEOUS NOTES.

Newark, N. J.—The Electrical Manufacturing Company of Newark has been incorporated by P. W. Roder and others with a capital stock of $5,000.

Electric Cutting Machines.—The Electric Cutting Machine Company has been incorporated at Chicago by F. W. Nevins and others with a capital stock of $500,000.

A New York Electric Commission.—Senator Coggeshall has introduced a bill in the New York Legislature, which was also before the Legislature last year, to provide for a State electric commission to supervise and regulate telegraph, telephone and electric light companies. The commission is to consist of eight members, to be nominated by the Governor and confirmed by the Senate.

BUSINESS NOTICES.

Trinidad Line Wire is showing its superiority by the large demands for it among electric light companies. See advertisement on page xvii.

Jordan & Gottfried, 208 Canal St., N. Y., carry a complete stock of iron and brass machine and wood screws, bolt cap and set screws, taps, dies, files, twist drills, brass and rubber tubing, rod and sheet copper, brass, German silver, steel and iron wire, shafting, tools, etc.

Johnston's Patent Agency Expert Work.—The activity of the Agency in this department has increased greatly during the past year, and the engagements now on hand indicate that there will be a still larger amount this year. Parties desiring patent searches made by experts, opinions on the validity of patents, or expert testimony in electrical patent casues, will find the work of the Agency satisfactory.

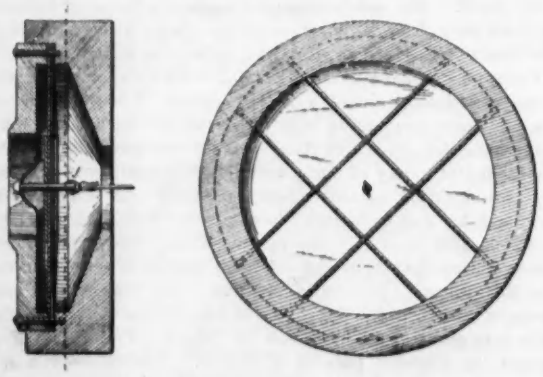
OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

PATENTS DATED JANUARY 24, 1888

376,730. Therapeutic Electric Belt; S. B. Bushfield, Denver, Colo. Application filed May 31, 1887. A belt is made up of concavo-convex discs provided with suitable openings for holding an absorbent material.

376,818. Electrical Conductor; T. Eggleston, New York N. Y., Assignor to the Plume & Atwood Manufacturing Co., Waterbury, Conn. Application filed Jan. 5, 1883. A covering of fibrous material is placed next to the conductor. This is saturated with a fire proofing material and then wrapped with tape and the whole sheathed with lead.

376,862. Means for Automatically Operating the Gates of Pneumatic Tubes and Similar Ways; R. M. Curtiss, Brooklyn, N. Y. Application filed June 11,



376,923. MECHANICAL TELEPHONE.

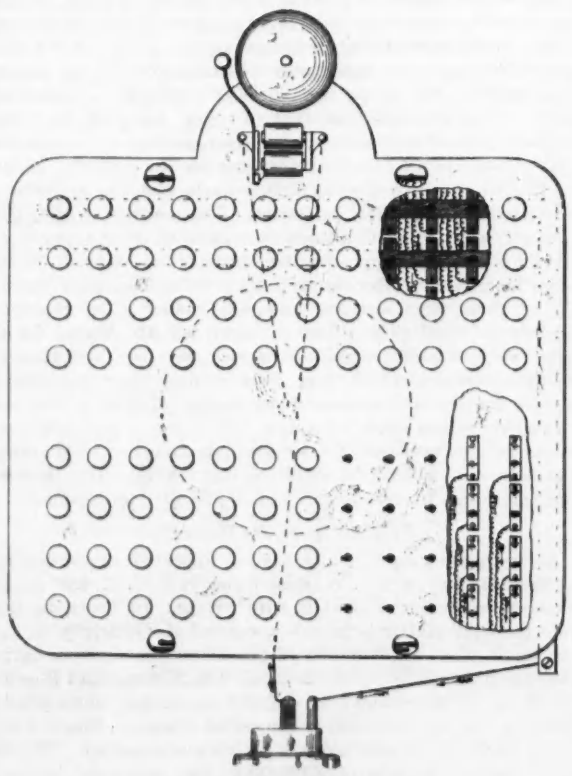
1886. The armature of a magnet is connected with a valve or gate in such a manner that when the magnet circuit is closed the gate is operated.

376,863. Electric Call; W. H. Cutting, St. Louis, Mo. Application filed June 14, 1887. This is an electric alarm which may be said to ring at any time desired. A pointer moves across the face of a plate provided with contacts. The contacts may be adjusted into or out of the path of the pointer according to the time at which it is desired the alarm should ring. See illustration.

376,923. Mechanical Telephone; J. P. Sunderland, Brooklyn, N. Y. Application filed July 21, 1887. A hollow cone filled with non-resonant material is placed in front of the diaphragm and the rod which connects with the line wire passes through and is secured to it. See illustration.

376,880. Circuit Closer and Regulator for Electro-Magnetic Thermoscopes; H. J. Haight, New York, N. Y. Application filed March 8, 1886. The invention consists in structural details.

376,893. Underground Conduit for Electric Wires; E. C. Lindemann, Baltimore, Md. Application filed Nov. 2,



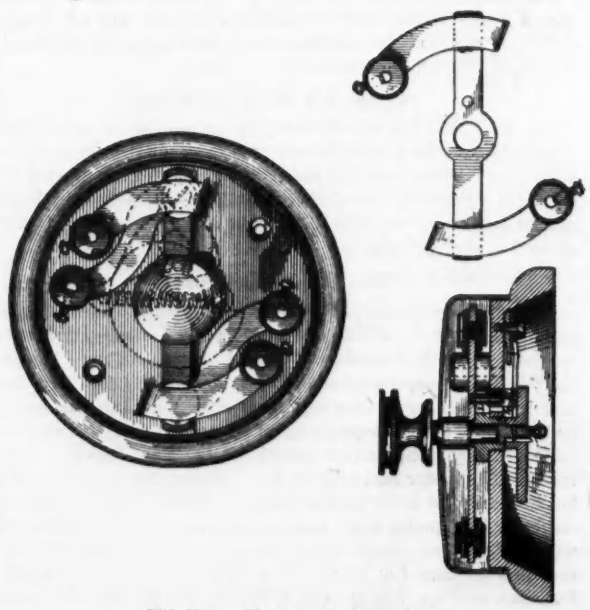
376,863. ELECTRIC CALL.

1887. The sections of the conduit are dovetailed into each other, and a key is used to make the joint tight.

376,920. Watchman's Electric Controlling Apparatus; O. Skrivan and F. Dvorak, Vinohrady, Prague, Bohemia, Austria-Hungary. Application filed Feb. 5, 1887. A clock-work operated by electricity.

376,973. Mechanism for Electrical Connection; P. W. and J. B. Wood. Montreal, Quebec, Canada. Application filed June 21, 1887. A hand or pointer is moved around the face of a plate which carries terminals of different circuits. A trunk wire runs to the hand and any connections may be made by moving the hand through the gearing provided for the purpose.

376,976. Electrical Switches; S. Bergmann, New York, N. Y., and J. T. Dempster, of Summit, N. J., Assignors to Bergmann & Co., of New York, N. Y. Application filed May



376,976. ELECTRIC SWITCH.

27, 1887. Two arms are moved by a cam, and they connect by means of springs with the contact pieces. Power is stored up by the cam in the springs, and the springs being suddenly released the contacts snap into position. See illustration.

Copies of the specifications and drawings complete of any of the patents mentioned in this record—or of any other patents issued since 1866—can be had from this office for 25 cents. Give the date and number of patent desired, and address Johnston's Patent Agency, Potter Building, New York.